How to Organize a Conference Using Bibliometrics?

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Abstract

The success of the organization of an international conference depends in a big extent on a considerable number of controversial decisions. Many of them are taken considering expert opinions, but some others are still based on more or less subjective criteria. In this study, we suggest and document that the inclusion of bibliometric and scientometric methods does not only facilitate the organization of a conference but also contribute to support and legitimate the decisions taken by its organizers. Bibliometric indicators and methods improve the quality of the selection process and introduce a broader view for the application of consolidated criteria. Additionally, mapping techniques appear as very adequate instruments for the assignment of contributions to the reviewers and for the compilation of the sessions resulting in the final programme. Finally, we recommend their use in the organization of conferences independent of their subject.

Introduction

By organizing the 10th International Conference on Science and Technology Indicators from 17th to 20th September in Vienna, we were confronted with a lot a controversial decisions that, normally, are mostly taken based on subjective criteria (as personal knowledge, "old boys" considerations, etc.). Looking for a more well-balanced and innovative solution, we found that the use of bibliometrics and in general of scientometrics can provide very objective criteria to support and regulate these decisions. Unfortunately, bibliometric methods are not used frequently for this purpose. Thus, we could not find any literature or documentation about that matter and decided to write this paper.

Some bibliometric methods have already been incorporated with success for the organization of the above mentioned conference successfully, as it will be described in this paper, and others have been later implemented in order to compile a complete bibliometric monitoring of any conference independent from its theme.

Selecting the conference themes and its title

Most of the conferences are being held with a determined periodicity varying between one and four years, so the main themes are precisely defined and don't need to be discussed. However, research evolves continually and new areas or topics are emerging, partially due to incorporation or splitting. Due to the steady increase in the number of both scientific publications and specialisation of scientists, it is becoming very difficult to keep an overview of the structure and dynamic development of a determined field of science.

Thus, the identification of "hot topics", "emerging research subjects" and new trends (changes of focus or methods) and their inclusion as new themes can improve the quality of the conference and at the same time ensure its actuality. For emergence we are using in this case the definition proposed by Goldstein (1999): "the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems". The

importance of "hot topics" is evidently illustrated by the number of publications dealing with their identification in many different subject areas. However most of these are written by experts relying on their knowledge and experience but not considering any bibliometric support (1,2).

Bibliometrically, hot topics are basing on hot papers, i.e. papers that receive citations soon after their publication, relative to other papers of the same field and age [3]. Generally, papers reach their citation peak some years after publication depending very strong on their subject field. A small group of papers, however, is recognized very soon after publication, reflected by rapid and significant numbers of citations. These papers can give a quick idea of which fields are drawing actually the attention of the researchers.

Web of Knowledge (WoK) offers a list of "hot papers" annually in its analytical tool "Essential Science Indicators- Hot papers" WoK uses a special filter to detect them, looking at recently published papers with unusual citation activity in a current time period and taking into account the varying citation rates across fields (see under http://esi.isiknowledge.com/highimpacthotpapersmenu.cgi?option=H). A paper is selected as a hot paper if it meets a citation frequency threshold determined for its field and bi-monthly group. Citation frequency distributions are compiled for each field and cohort. Thresholds are set by finding the closest citation count that would select the top fraction of papers in each field and period. The fraction is set to retrieve about 0.1% of papers. In this tool, hot papers can be displayed by field (22 optional fields) or searched by title word, scientist, institution, country/territory or journal. The search does not always yield suitable results, due to the exiguous number of optional fields and to the fact, that their assignment is made at journal and not article level.

Thomson also offers its additional resources "Science Watch", tracing hot or emerging fields as well as national and international trends in basic research with this bimonthly newsletter, and "Special Topics" with free citation analyses and commentary about today's most notable scientific research areas.

Other, much more sophisticated methods, are based on mapping science: maps depicting the structure and evolution of scientific fields, also called knowledge domain visualizations (KDVs), using special visualization techniques to study, analyze, organize and manage large complex information spaces. KDVs are usually generated semi-automatically from static data sets collected for a considered knowledge domain. New visualization techniques are producing global maps while zooming in on designated areas identifies recently emergent fronts. Providing a quick and general visual overview, revealing hidden patterns, relations or linkages and displaying them from several perspectives simultaneously, they can be efficiently used to objectively and dynamically trace the shifting fashions in research and the emergence and evolution of topics. Different techniques can be used to create such maps of science: the co-citation technique, the co-word-technique and the combination of both. Mapping science is performed by means of relational, two-dimensional indicators that are based on the analysis of the co-occurrence, that means the number of times different indicators or information items, such as author names, keywords, classification counts or citations, occur together.

While it is relatively easy to map science output by authors, affiliations or nations, it is far more difficult to describe subject matter or descriptors. A priori classification systems do not work well, mainly because of the use of different hierarchical structures, the missing of adequate thesauri in multidisciplinary data sources and the fact, that subject category assignment in WoK is made at journal and not article level. To avoid this problem, Henry Small, and independent in Moscow Irina Marshakova, introduced about 35 years ago co-citation mapping. These maps are created on the basis of citations given by authors in their publications and how often pairs of articles are cited together

However, the most used techniques for the identification of emergent fields are the co-word occurrence and the identification of new introduced terms (emergent terms). For example, Mane and Börner (2004) presented an interesting way to generate co-word association maps of major topics based on highly frequent words and words with a sudden increase in usage, a phenomenon called "burst". They utilized co-word occurrence analysis implemented by Kleinberg's burst detection algorithm and graph layout techniques to generate maps that support the identification of major research topics and trends..

During the last years, a lot of more or less sophisticated models have been developed to identify and study emerging fields. For example, Bettencourt et al (2008) analyzed the temporal evolution of emerging fields within several scientific disciplines in terms of numbers of authors and publications using population contagion models, suitable adapted from epidemiology to reflect the dynamics of scientific interaction.

Combination of different methods and techniques are also of increasing interest, as for example, the combination of bibliometric mapping and citation network analysis to investigate the process of creation and transfer of knowledge through scientific publications (Calero Medina & Noyons, 2008).

Resuming, bibliometric methods and specially mapping techniques can offer a valuable and objective support by the identification of "hot research topics" and emergent areas" in order to delineate the main themes of a conference. A practical example will be shown in the next sections.

In the case of the 10th International Conference on Science and Technology Indicators we had chosen a mix of traditional themes and new topics, see Table 1. Theme 1 is the traditional core theme of the conference and includes all scientific work around performance and impact indicators. For this conference the upcoming Theme 5 was new as well as Theme 2. Theme 4 and Theme 7 were included on behalf of the current discussions in the scientific community. Theme 6 was chosen to emphasize the importance of the bibliometric data sources and to signalize that they still have a lot a deficiencies influencing severely the quality and interpretation of scientometric analyses.

Table 1. Themes of the 10th International Conference on Science and Technology Indicators

Theme 1	Quantitative and qualitative approaches: a special focus in evaluation of the academic performance
Theme 2	S&T indicators for the identification of emerging fields
Theme 3	Disciplinary relevance of bibliometric indicators: Science and Technology, Social Sciences and Humanities
Theme 4	Interactions between Open Access initiatives and scientometrics
Theme 5	Visualisation and Science Mapping: tools, methods and applications
Theme 6	Accuracy and reliability of data sources for scientometric studies
Theme 7	Management and measurement of bibliometric data within scientific organisations

Figure 1 shows the distribution of the contributions presented per theme; in total: 163. Due to the fact that the authors indicated more than one theme there are multiple entries of contributions. Theme 1 had received the most attention measured by the number of contributions. It is interesting that visualisation and science mapping as well as the identification of emerging fields are very strong in the focus of research interest. Unexpectedly, theme 4 received only a few contributions in contradiction to its actuality.
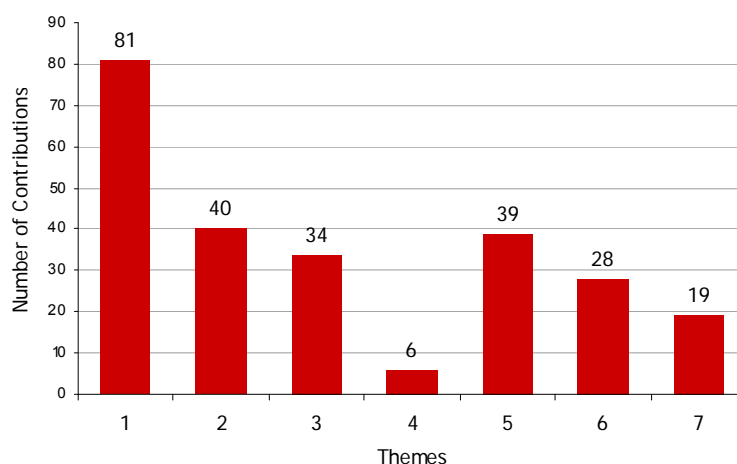
Figure 1. Number of contributions after the call for papers per theme

Selecting peer reviewers

After, or even better, during the call for papers, the local committee will concern itself with the selection of referees or peer-reviewers and ensure their participation for the indispensable review process in order to guarantee for the content quality of the conference.

Except new launched ones, most of the international conferences inherit the list of the international committee of the precedent one and only need to update those with novel authors of hot topics and new emergent areas. However, we are suggesting some bibliometric methods supporting this decision, independently from already existing lists and enabling their control or updating.

Usually, three reviewers are needed for each paper and it can be assumed that each one of them will be reviewing between 3 and 5 papers. Thus, if from the call for papers Y papers came in (for example 250), a number of 3Y/5 reviewers will be at least needed.

One of the first possibilities, very modern at the moment, is retrieving all the scientists with higher "h-index" in the subject field covered by the conference. The "h-index" is an index introduced by Jorge E. Hirsch giving a quantitative approach of both the actual scientific productivity of a scientist and its scientific impact measured by the number of citations received. A scholar with an index of h has published h papers each of which has been cited by others at least h times. For physicists, for example, a value for h of about 10-12 might be a useful guideline for tenure decisions at major research universities, a value of about 18 could mean a full professorship, 15–20 could mean a fellowship in the American Physical Society, and 45 or higher could mean membership in the United States National Academy of Sciences. Thus, similarly, a value for h can be introduced for a conference reviewer. Let us suggest for example about 15 for Physics. The h-index, like most of the bibliometric indices or indicators, is strongly dependent of the subject field considered but can be easily determined for every specific area and is presently calculated in many different fields (for example, for Chemistry, http://www.rsc.org/chemistryworld/News/2007/April/23040701.asp). So it can be well used to give a first suggestion for the reviewer selection, but may also provide misleading information if used exclusively: The h-index is bounded per definition by the total number of publications. This means that scientists with a short career or less publications are at an inherent disadvantage, regardless of the impact of their publications. Citations per paper, or even the bare number of publications highly cited or published in journals with higher impact factor as the aggregated one in this subject category are as well interesting reference points for this decision.

A much more elegant method would base on the citation classics (http://garfield.library.upenn.edu/classics.html). Citation classics were introduced 1977 by Eugene Garfield as a new feature of Current Contents. A Citation Classic is a highly cited publication as identified by the Web of Science. Citation rates differ for each discipline. In general, a publication cited more than 400 times should be considered a classic; but in some fields with fewer researchers, 100 citations might qualify. Citation classics can be obtained as results of co-citation clustering by zooming from the most general global level down to the smallest research front (Garfield, 1998). At the lowest level a research front is identified by groups of co-cited core papers – from 2 to an arbitrary maximum of 50. And for each new annual research front there is an annual count of currently published papers that cite into those core papers. Authors of the co-cited core-papers would seem to be optimal candidates to become reviewers in these topics.

Figure 2. Co author map of 500 highest cited papers in bibliometrics; source WoS, topic=bibliometric*, years: 2000 to 2009, sort by: Times Cited

A very quick approach is easily obtained by retrieving in Web of Science the 500 most cited papers and calculating their co-author map, as we did for publications dealing with bibliometric results (topic=bibliometric*) and can be found in Figure 2. The relevance of the co-authorship will be elucidated in the next section.

As every paper should be reviewed at least by three referees, an optimal combination of the several bibliometric indicators or indices mentioned above could yield to an acceptable criterion, for example: one reviewer with high h-index, one reviewer as author of a core-paper and one reviewer as author of a hot topic or new research front.

A much more delicate problem is that there are not enough reviewers available in every research field and that after a determined time they are endangered of becoming a closed group of "old boys".

Assigning papers to peer reviewers
The pre-condition to assign the right contribution to the right reviewer is to match the content of the paper with the competence of the reviewer.
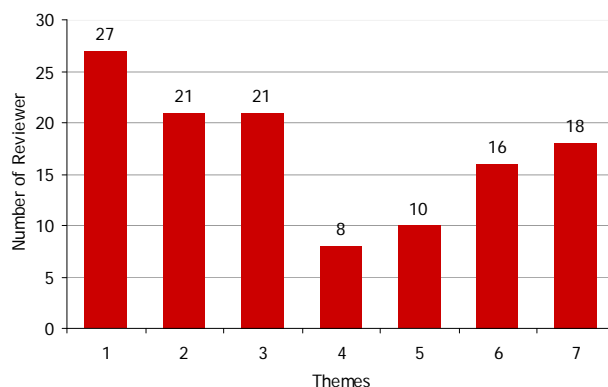

Figure 3. Number of reviewers per conference theme.
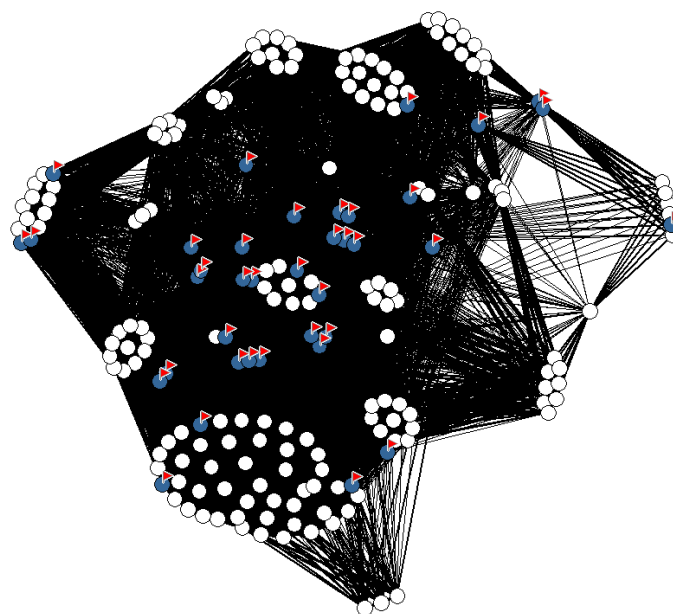
Figure 4. Hybrid co word map of reviewers and contributions, coloured and tagged circles are the reviewers, the others the contributions, edges are defined by the Jaccard index of the co occurrence in common themes

The easiest way is, to ask the authors to allocate their contribution to one or several conference themes and the members of the scientific committee, who act as reviewers, to state the themes, where they feel to be competent in. Figure 3 shows the frequencies of themes by reviewers. Due to the fact that the reviewers indicated more than one theme there are multiple entries of reviewers. There is a slight correlation between the distribution of Figure 1 and Figure 2, therefore a good fit of contributions and reviewers should be possible. The

visualisation of the problem ist shown in Figure 4. It represents a hybrid co-word map of reviewers and contributions of the mentioned conference.

The set of common competences of contributors and reviewers is defined by the themes of the conference. The co-occurrence in common themes is a criterion of similarity between the abstracts and the reviewers. As it can be seen in Figure 4, some reviewers are very close to a set of abstracts. In this case the reviewers and the abstracts have the same "competence", i.e. both are assigned to the same single theme (only one theme!). Those circles in between were assigned to more than one theme. If they have two, for example 1 and 2 they are positioned between the clusters that are formed by theme 1 and theme 2. The procedure of assignment of abstracts to reviewers starts with one paper and assigns it to the reviewers with the highest Jaccard index, that means to those with the same single theme The following papers are assigned to the next reviewer with the highest Jaccard index and so on. Thus, first those reviewers having the same theme and the lowest number of themes are assigned with each abstract. In our case the procedure worked very satisfactorily and no reviewer rejected any abstract because of insufficient competence.

This procedure can be ameliorated by considering more a priori information about the objects, for example, the description of the reviewers competence could be implemented by an analysis of their publications and compilation of characteristic keyword sets. These vectors could be matched at the same time with vectors resulting from the extraction of keywords or an automated indexing of the submitted abstracts.
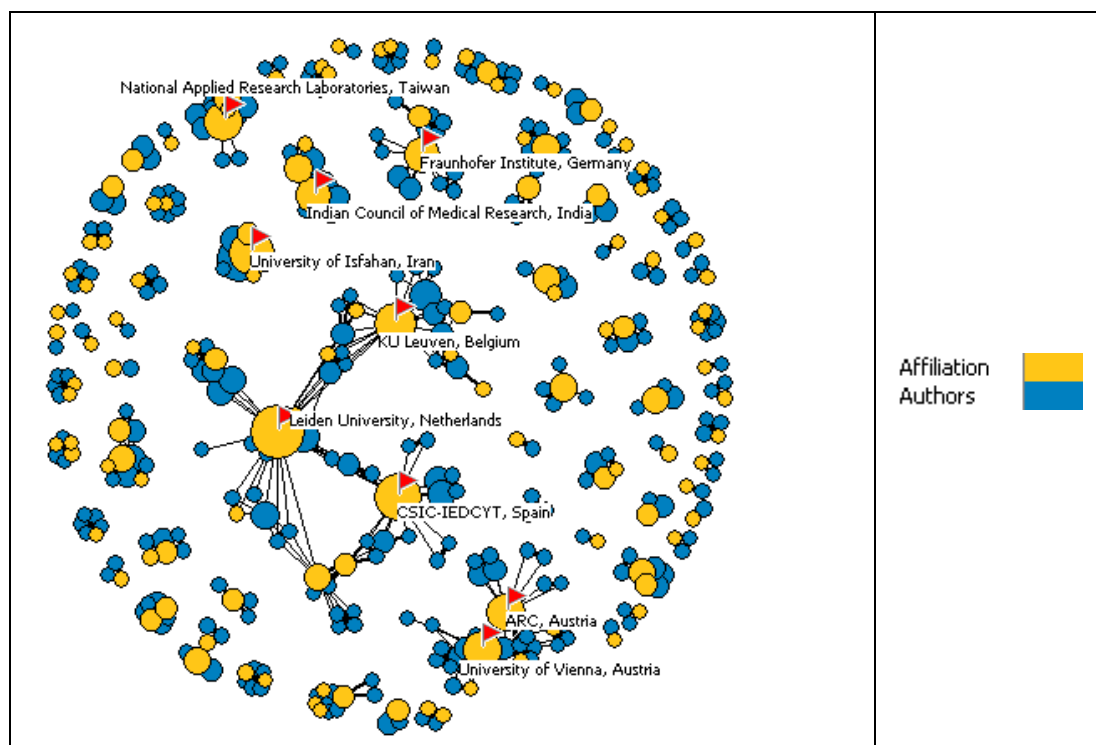
Figure 5. Authors and Affiliations by Contributions (Coloured: Author, Affiliation); data basis: all contributions received including rejected, accepted and shortly added contributions (in total: 163 contributions).

Of course there are some constraints to be taken into account: the reviewer should not be a co author as well as he should not have the same affiliation like any one of the authors of the submitted contribution. The co-author map shown in Figure 2 and the also computed co-affiliation map (see Figure 5) may help by considering these incompatibilities.

Results of the Review Process

It is very uncommon to publish the results of a review process. But there are two interesting question concerning the evaluation of the papers: one concerning the quality of papers and the other concerning the reviewers' trend to give high or low values. In our case the reviewers could assign an overall score between 1 and 10. The score of 1 was for rejecting an already published paper and 10 for an excellent paper.

Figure 6. Number of Contributions per Score awarded by the members of the International Programme committee

As it can be seen in Figure 6, the scores of 1 and 10 were not used and there is a bias to better evaluation results because of the high number of contributions with a score of 7 and 8. Furthermore on the distribution shows that there are only 3 very good papers and the over all quality is clearly more than medium. This was a strong reason to reject only a few numbers of papers.

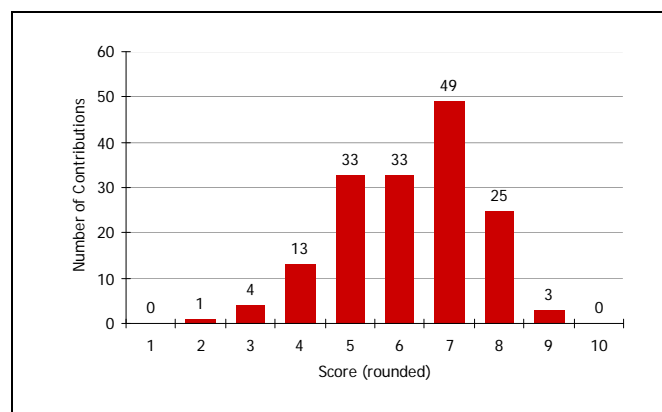A quick analysis of the homogeneity of the reviewers evaluation performed by a member of the local committee showed than only for less than 20% of the scores given differed more than three points.

Following supplementary criteria are recommended to be considered for the acceptance of presentations and posters at an international conference (Moed, 2008):

1) Consideration of geographical aspects in order to guarantee the international character of the conference. Publications of countries with very low representation should be promoted.
2) No participant should present more than one contribution (but he can be co-author of several contributions presented by other co-authors)
3) The thematic scope and content of the conference must be assured: enough contributions in every thematic focal point
4) Contributors with the ability to give very good lectures should be favoured in order to enhance the interest and quality of the conference. They also can even be invited for special lectures or keynotes.

Compilation of Sessions

The compilation of sessions is a complex problem because several criteria should be integrated: topics of the conference should be reflected in the thematic choice of sessions, lectures in one session should focus on the same area and simultaneous sessions should not deal with the same focal points. If a single session includes three or four presentations at most, a huge thematic cluster of papers must be divided in several sessions.

We used a mapping method combined with a hierarchical cluster analysis to arrange the sessions. First we grouped the contribution according to the conference themes which the

authors assigned to their papers, see Figure 7. it can be seen that there are contributions with only one theme assigned, they are coloured by the conference theme. Contributions with more than one assigned theme are in between, like the contributions labelled with the theme"4+6" or "2+7". Contributions with 3 assigned themes are placed more in the centre i.e. in the middle of their triangle.
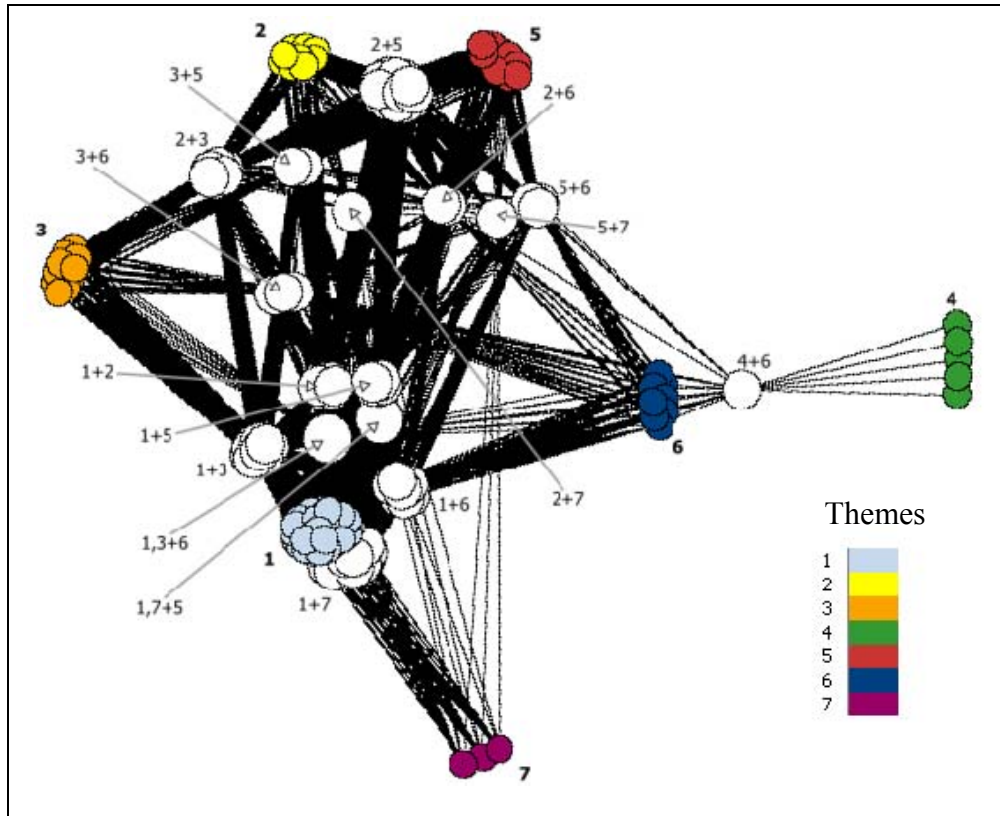
Figure 7: Co word map of contributions, nodes are the contributions, the size represents the number of assigned themes, the edges are defined by the Jaccard index of the co-occurrence of contributions in themes, (in total: 163 contributions).

In general the contributions to a conference do not always fit exactly to the themes, therefore we had to find a more in depth criterion for clustering the lectures. We took the keywords of the extended abstracts and a classification elaborated by an expert (in this case, our programme co-chair, Henk Moed) and implemented by the members of the "Local Organizing Committee" and calculated some more mappings. The results are shown in Figure 8.
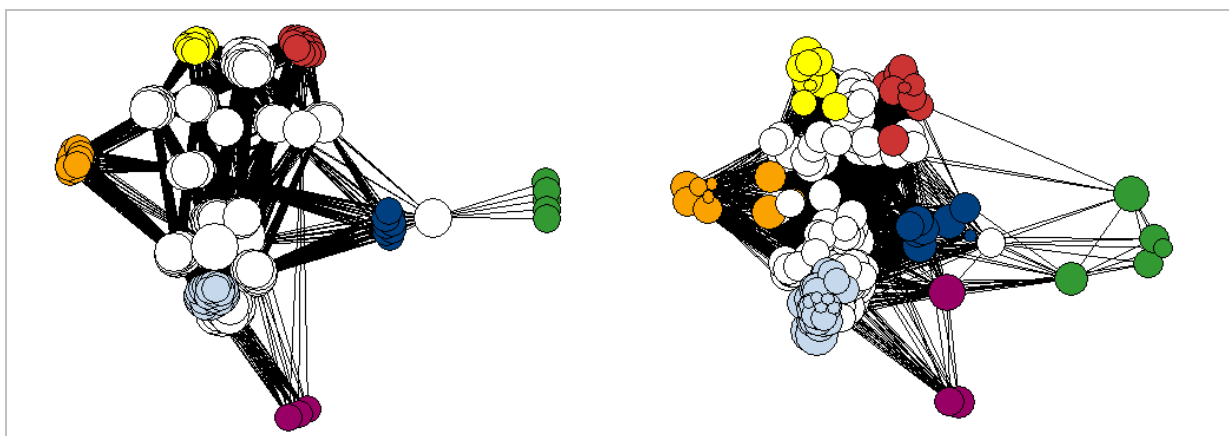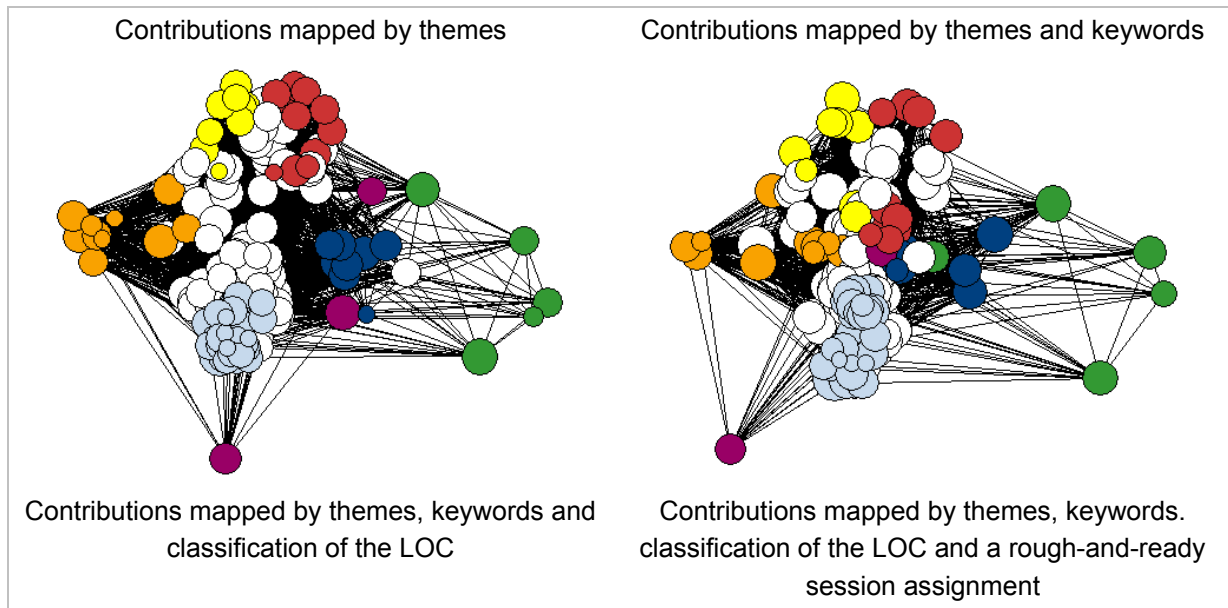
Figure 8: Co Word Maps of contributions by different criteria

The figure 8 demonstrates that the consideration of more criteria dissolve the primary structure of the thematic clustering of the contributions and enfeeble the tendency of the objects to move to the centre.

A good procedure to compile sessions is to start with a rough-and-ready approach for a first shot, then to take the papers and try to group them by an intuitive way. At last, a cluster analysis based on the mentioned criteria was performed, see Appendix 1 and the location of each lecture was approved. In the end, we had a session structure, reflecting all the mentioned criteria and a good thematic fit of lectures in the sessions.

Finally, the programme chairs and the local organizing committee arranged the sessions to a final programme, considering other organization factors, like time schedule and location plan. The chairs of the sessions were selected considering the same criteria as for the reviewers.

Conclusions:

Bibliometric and scientometric methods definitely help to improve the quality of the organization of a conference. They improve the selection process, introduce a broader view for the application of consolidated criteria and legitimate the decisions taken by the organizers and specially the "Local Organizing Committee".

Bibliometric and scientometric concepts, like "hot topics", "emergent fields", "citation classics", or indicators, like the number of publications, number of citations per publication, h-index, et al.., are an unquestionable help for the selection process not only of the conference themes but also of the reviewers or members of the international committee.

Mapping techniques basing either on co-citation or on co-word-occurrence deserve a quick and general visual overview, reveal hidden patterns, relations or linkages and display them from several perspectives simultaneously. Therefore, they can be very well and helpfully used to assign submitted contributions to adequately selected reviewers and to compile accepted presentations and posters in interesting and well-grounded sessions, preparing an interesting conference programme.

Resuming, this study shows why bibliometric and scientometric methods are of big importance for the organization of conferences independently from their subject. We recommend their consideration and use for this purpose basing on our own experience

accumulated during the organization of the 10th International Conference on Science and Technology Indicators held in Vienna from 17 to 20 September 2008.

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Appendix 1. Hierarchical cluster analyses and final arrangement of contributions into sessions

Legend:

Th = Thursday
Fr = Friday
Sa = Saturday

Numbers: contributions
Names of the sessions: the sessions in which the contributions finally

Level 2

Level 3

Contribution	Session
130	Poster Session 2 Fr
141	Poster Session 2 Fr
36	Plenary Session 1 Th
101	Parallel Session B1 Th
107	Parallel Session C6 Sa
139	Poster Session 2 Fr
162	Parallel Session A3 Fr
164	Parallel Session C6 Sa
167	Parallel Session A6 Sa
34	Parallel Session C6 Sa
116	Parallel Session B1 Th
124	Parallel Session B1 Th
178	Poster Session 2 Fr
181	-
186	Parallel Session B4 Fr
52	Poster Session 2 Fr

Contribution	Session
114	Parallel Session A2 Th
53	Parallel Session B2 Th
61	Poster Session 2 Fr
143	Parallel Session A5 Fr
38	Poster Session 2 Fr
89	Parallel Session B2 Th
105	Plenary Session 1 Th
128	

Contribution	Session
168	-
120	Poster Session 2 Fr
14	Poster Session 1 Th
92	Poster Session 1 Th
113	Poster Session 1 Th
118	Poster Session 1 Th
175	Poster Session 1 Th
41	-
42	-
72	Poster Session 2 Fr
84	Poster Session 1 Th
176	Poster Session 1 Th
71	-
85	Poster Session 1 Th
88	Poster Session 1 Th
97	Poster Session 1 Th
10	-
155	-
90	Poster Session 1 Th
91	Poster Session 1 Th
51	Poster Session 1 Th

Contribution	Session
165	Plenary Session 2 Fr
187	Parallel Session C3 Fr
55	Plenary Session 2 Fr
86	Parallel Session A5 Fr
95	Parallel Session A5 Fr

Contribution	Session
103	Poster Session 2 Fr
136	Poster Session 2 Fr
117	Poster Session 2 Fr

Contribution	Session
13	-

Contribution	Session
152	-
142	Parallel Session B4 Fr
151	-
161	Parallel Session C4 Fr
179	Parallel Session A2 Th
33	Parallel Session A6 Sa

Contribution	Session
24	Parallel Session C5 Fr
100	Plenary Session 3 Sa
109	Parallel Session C5 Fr
68	Plenary Session 3 Sa
17	Parallel Session C5 Fr
127	Parallel Session C4 Fr
30	Parallel Session C5 Fr

Contribution	Session
22	Plenary Session 3 Sa
56	Parallel Session A6 Sa
23	Plenary Session 3 Sa
62	Parallel Session C2 Th
60	Parallel Session C6 Sa
184	Poster Session 1 Th
28	Parallel Session B2 Th
81	Parallel Session C4 Fr
27	Parallel Session A6 Sa

Contribution	Session
80	Parallel Session A1 Th
26	Parallel Session A1 Th
134	Parallel Session A1 Th
106	-
126	-
144	-

Contribution	Session
122	Parallel Session C3 Fr
48	Parallel Session C1 Th
159	-
173	Parallel Session B3 Fr
32	Parallel Session B3 Fr
21	Parallel Session B4 Fr
37	Parallel Session B3 Fr
67	Parallel Session C3 Fr
188	-

Contribution	Session
140	Poster Session 2 Fr
123	Parallel Session A3 Fr
133	Parallel Session C2 Th
57	Parallel Session A2 Th
163	Parallel Session A3 Fr
64	Parallel Session C2 Th

Contribution	Session
50	Parallel Session B5 Fr
129	Parallel Session B5 Fr
25	Parallel Session B5 Fr
104	Parallel Session C1 Th
145	-
146	-

Contribution	Session
35	-
82	-
78	-

Contribution	Session
15	-
19	-
12	Poster Session 1 Th
66	Poster Session 1 Th
70	Poster Session 1 Th
154	Poster Session 2 Fr
185	Poster Session 1 Th
75	-
31	Poster Session 1 Th
94	-

Contribution	Session
149	Parallel Session A4 Fr
148	-

Contribution	Session
108	Poster Session 1 Th
11	-
121	Parallel Session A4 Fr
169	Poster Session 2 Fr
47	Parallel Session A4 Fr

Contribution	Session
157	Parallel Session A5 Fr
63	Parallel Session A2 Th
147	-

Contribution	Session
131	Poster Session 2 Fr
102	Parallel Session B6 Sa
39	Parallel Session B6 Sa
44	Parallel Session B6 Sa
40	Parallel Session B6 Sa

Contribution	Session
46	Parallel Session C1 Th
110	Poster Session 2 Fr
153	Poster Session 2 Fr
76	Parallel Session C2 Th
119	Poster Session 1 Th
166	-

Contribution	Session
160	Poster Session 2 Fr
171	Poster Session 1 Th
54	Poster Session 2 Fr
58	Poster Session 2 Fr
29	Poster Session 1 Th

Contribution	Session
172	Poster Session 1 Th
174	Poster Session 2 Fr
182	Poster Session 1 Th

Contribution	Session
16	-
132	Poster Session 1 Th
18	-

Contribution	Session
65	Poster Session 2 Fr
87	Poster Session 1 Th
45	Poster Session 2 Fr
69	Poster Session 2 Fr

Contribution	Session
137	Poster Session 2 Fr
158	Poster Session 2 Fr