

A Review of CRIWG Research

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Abstract. This paper presents a meta-analysis of the CRIWG conference. The study is organized in three main sections: bibliometric analysis, analysis of references and subject analysis. The bibliometric analysis indicates that CRIWG is significantly above the average citation index of similar papers published in LNCS. The analysis of references shows a significant dependence on ACM papers and very low cross-referencing between CRIWG papers. The subject analysis reveals that CRIWG slightly favors positivist evaluations, although almost half of the papers do not present any type of evaluation. We conclude this study with a discussion over strengths, weaknesses, opportunities and threats.

Key words: Meta-analysis, CRIWG review.

1. Introduction

This paper is intended for the 16th edition of the CRIWG¹ conference. As a round number (2⁴), it may trigger an appropriate time to reflect on the past contributions of this conference and the outlook for the future. The authors would then like to present some data gathered from the previous proceedings and elaborate some analysis and discussion. We expect this to be the starting point of a rich and controversial interchange of viewpoints during the conference itself.

CRIWG started in Lisbon, Portugal, in September 1995. It was initially thought to be a meeting to exchange research approaches in the field of Groupware for a few groups. Instead of establishing an informal gathering, a decision was made to make it scientifically valid through the commonly accepted peer-reviewing process, using anonymous submissions and reviews, and circulating the papers in proceedings distributed by international scientific publishers. The conference has kept this tradition up to now.

CRIWG has some unique features when compared with other conferences in the field. It has just one track, with full papers and work-in-progress ones. The

¹ Which now is an acronym for the Collaboration Researchers International Working Group on Groupware.

presentation of the papers provides ample time for discussion, giving thus authors very valuable feedback. The conference also encourages social interaction among participants. Finally, the conference has been organized in interesting places around the world, but this has not been obstacle to sustained presence by participants to all sessions.

We will present some data extracted from the proceedings, we will analyze it and try to make suggestions for the future of the conference. The analysis, of course, is the authors' responsibility and it does not represent an official statement from the conference committees.

2. Methodology

Most of this review is based on information provided by Thomson Reuters ISI Conference Proceedings Citation Index (ISI, for short). We analyzed all CRIWG papers published between 2000 and 2008. Our intention was to cover the set of proceedings published by LNCS and IEEE between 1999 and 2009. However, for some unknown reason the joint SPIRE/CRIWG 1999 conference was not found in ISI; and the 2009 papers were not yet available in December 2009, when the data was gathered.

Gathering the list of papers from ISI was not completely straightforward, requiring combined searches using the CRIWG acronym and the Groupware keyword, plus manual inspection to remove spurious references to other journal and conference papers. The consolidated data set used in most of our analysis consists of 246 papers.

The review was separated in three main goals: bibliometric analysis, analysis of references and subject analysis. The bibliometric information, such as the Hirsch index (h) [1], was automatically produced by ISI and gives a summative assessment of CRIWG.

Our main purpose to analyze the CRIWG references to other papers was to understand how CRIWG views and positions itself relatively to other research fields. The references were automatically obtained from ISI, exported to Endnote and exported again to Excel, which was then used to discover the main referenced papers, authors and sources. It should be emphasized the references exported by ISI present some shortcomings. For instance, they do not identify all authors. Furthermore, conferences and journals are formatted with multiple short names. A considerable effort was done to normalize the data and obtain the consolidated information reported in section 4.

The subject analysis follows a method that has been adopted by similar reviews (e.g., [2-4]). The method uses qualitative data analysis techniques to code the data set using multiple tags [5]. Unlike some reviews that use a predefined set of tags, we adopted a grounded approach [6] where the keywords emerge as the analysis progresses [5]. The main categories considered during the grounded coding were: research objective, research topic and type of evaluation. Two coding rounds were performed to ensure consistency.

The coding process was applied to the 246 paper abstracts obtained through ISI. This might be viewed as a controversial decision, since coding could instead be applied to the full paper bodies. The basis for our decision to only code abstracts was: (1) the abstracts should be considered accurate and concise summaries of the authors' research, done by the persons most fit to accomplish them, i.e. the authors themselves; (2) abstracts have an implicit structure that is totally aligned with the coding categories mentioned above; and (3) this structure is typically checked and enforced by peer reviewers.

During the coding process we confirmed the type of information we were reviewing was available in the abstracts, which made the access to the remaining information unnecessary. We nevertheless point out the search for more fine-grained information, including for instance reviewing which specific techniques, tools and algorithms were researched, would necessarily mandate a full body analysis.

We finally note the trend lines shown in the paper are all polynomial functions. The R^2 appearing near the trend lines was automatically calculated using Apple's Numbers.

3. Bibliometric Analysis

The total number of CRIWG papers considered in the bibliometric analysis is 246. The total number of citations to these papers is 336, which gives an average citation per paper of 1.37. The obtained h-index is 6.

The distribution of citations per year is shown in Figure 1. After an expected ramp up of citation activity from 2002 to 2005, the number of citations has stabilized since 2006 at an average of 48 cites/year.

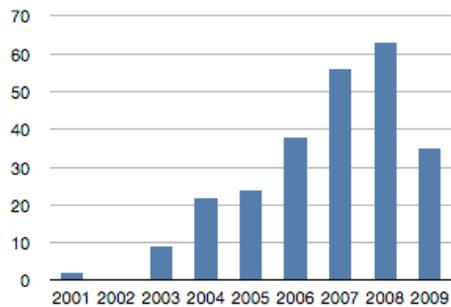


Fig. 1. Distribution of citations per year

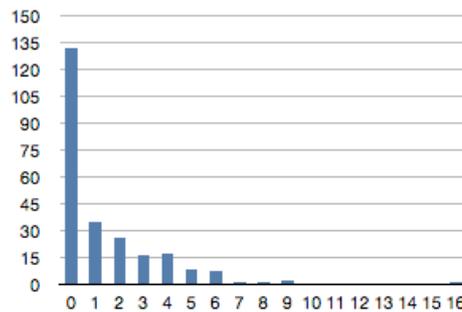


Fig. 2. Distribution of citations per paper (number of citations in horizontal axis)

As shown in Figure 2, 132 papers (53%) have not received any citation. This indicates that CRIWG, although having a selection of good papers, has to improve the selection process.

3.1 Comparison with other conferences

The information conveyed above might be difficult to analyze without a frame of reference. In order to create such reference we tried to compare CRIWG with other conferences related with CRIWG and also reported by ISI. The following conferences were selected: COOPIS (Conference on Cooperative Information Systems, now part of OTM - On The Move Confederated Conferences), WET-ICE (Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises), DSV (International Workshop on Design, Specification and Verification of Interactive Systems) and CONTEXT (International and Interdisciplinary Conference on Modeling and Using Context). Furthermore, we also contrasted the CRIWG bibliometrics with a broad set of papers collected from ISI using a search for “LNCS” and “Conference”.

Table 1. Comparison with other conferences

Name	COOPIS	DSV	CRIWG	CONTEXT	WET-ICE	LNCS
Years	01-07	98-07	01-08	00-07	96-06	90-09
Nr. papers	379	163	246	194	524	8746
Times cited	703	237	336	235	274	9103
Av. citation	1.85	1.45	1.37	1.21	0.52	1.04

The results shown in Table 1 indicate that CRIWG, in terms of quality measured by citation indexes, is above average when compared with the other selected conferences (1.37 against an average of 1.28) and significantly above the average citation index of a large collection of papers published in LNCS.

3.2 Top 5 cited papers

The top 5 cited papers are shown in Table 2.

Table 2. Top 5 cited papers (number of citations on the left)

16	Rosa MGP, Borges MRS, Santoro FM (2003) A conceptual framework for analyzing the use of context in groupware, 9th International Workshop on Groupware, 2003, Autrans, France, LNCS, vol. 2806, p. 300-313
9	Haake JM, Schummer T, Haake A, et al. (2003) Two-level tailoring support for CSCL, 9th International Workshop on Groupware, Autrans, France, LNCS, vol. 2806, p. 74-81
9	Collazos CA, Guerrero LA, Pino JA, et al. (2002) Evaluating collaborative learning processes, 8th International Workshop on Groupware, La Serena, Chile, LNCS, vol. 2440, p. 203-221
8	Neyem A, Ochoa SF, Pino JA (2006) Supporting mobile collaboration with service-oriented mobile units, 12th International Workshop on Groupware, Medina del Campo, Spain, LNCS, vol. 4154, p. 228-245
7	Moran AL, Favela J, Martinez-Enriquez AM, et al. (2002) Before getting there: Potential and actual collaboration, 8th International Workshop on Groupware, La Serena, Chile, LNCS, vol. 2440, p. 147-167

3.3 Top 10 authors

Table 3 presents the list of authors according to the number of papers published in the proceedings.

Table 3. Top 10 authors (number of papers on the left)

19 Pino JA	12 Ochoa S
17 Antunes P	12 Guerrero L
15 Borges MRS	10 Baloian N
14 Favela J	9 Lukosch S
14 Collazos C	7 Vreede GJ
	7 Fuks H

3.4 Country distribution

A total of 29 countries have been represented in the conference series. Figure 3 indicates the internationalization ratio has slightly increased between 2000 and 2004 and slightly decreased in 2007 and 2008.

Table 4. Country distribution

44 Brazil	3 Costa Rica
34 Chile	3 Finland
30 Germany	3 Japan
27 Portugal	2 England
24 Spain	2 Greece
22 France	2 Norway
22 USA	2 Taiwan
21 Mexico	1 Australia
13 Netherlands	1 Austria
8 Colombia	1 Belgium
6 Argentina	1 Luxembourg
6 Canada	1 Romania
4 China	1 Scotland
4 Korea	1 Sweden
	1 Switzerland

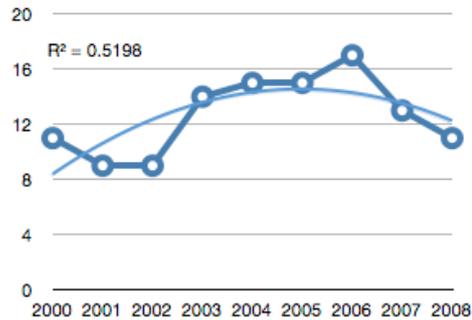


Fig. 3. Internationalization (countries/year)

3.5 Collaborative research

As mentioned in the introduction, CRIWG aimed to promote the participants' socialization. This should allow researchers to meet potential partners for future projects. These researchers will probably return to the CRIWG conference to present the new joint results. A reasonable hypothesis then is to assume the proportion of papers presented by researchers from two or more institutions would increase in time.

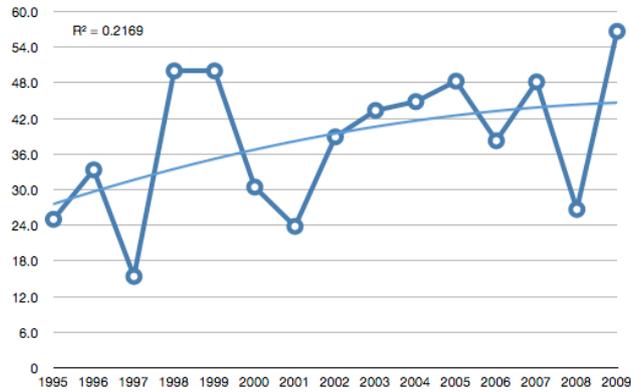


Fig. 4. Percentage of collaborations by year

Figure 4 shows the evolution of the number of collaborations for the whole CRIWG period (1995-2009), represented as a percentage of the number of papers published in each year. This data was manually gathered from the proceedings. It shows the proportion of papers presented by two or more research groups slightly growing in time (groups from different departments of the same university were considered as just one group). Of course, the contribution from the conference may not be the only reason for this increase. Other factors may influence this result, like appearance of grants supporting research from more than one country, etc. However, in our own personal experience, CRIWG helped us finding research partners.

3.6 Special issues in ISI Journals

Table 5 summarizes the special issues in ISI Journals published with extended versions of papers presented at CRIWG conferences. The total number of papers is 46 (18.7% of all papers published by the Proceedings in the 2000-2008 period). The number of citations is 99. The average citation index is 2.15, which is significantly higher than the one obtained by the proceedings. There is also in press one special issue of the Group Decision and Negotiation journal containing extended versions of papers presented at the 2008 conference.

Table 5. Special issues in ISI journals

Journal name	No. of issues	No. of papers published
Int. J. of Cooperative Information Systems	2	10
Int. J. of Human-Computer Studies	1	5
Journal of Universal Computer Science	2	10
Computing and Informatics	1	5
Group Decision and Negotiation (*)	2	12
Multimedia Tools and Applications	1	4

(*) The 2008 issue is in press.

Besides the special issues in ISI-indexed journals, there have been special issues in other journals, as reported in Table 6.

Table 6. Special issues in other journals

Journal name	No. of issues	No. of papers published
Int. J. of Computer App. and Technology	1	9
International Journal of e-Collaboration	1	4
e-Service Journal	1	5
Journal of CLEI	1	1

4. Analysis of References

The analysis of references gives a good indication of how CRIWG perceives its research community. The references were automatically obtained from ISI using the set of 246 papers published between 2000 and 2008. References to technical documentation and web sites were manually removed from the data set.

Table 7. Analysis of references

Total number of cited papers: 4524 Average number of references per paper: 19.15 (stdev: 8.6)
References to ACM papers: 653 (14%) ACM Transactions: 98 Communications of ACM: 134 Proceedings of ACM: 338 Proceedings of ACM CSCW: 187 Proceedings of ACM CHI: 61
References to LNCS papers: 229 (5%) References to IEEE papers: 196 (4.3%) References to Thesis: 112 (2.5%) References to HICSS papers: 90 (2%) References to CRIWG papers: 84 (1.9%) References to ECSCW papers: 35 (0.8%) References to LNAI papers: 14 (0.3%)

The results summarized in Table 7 indicate a significant dependence on ACM papers. The data also indicate very low cross-referencing between CRIWG papers. In the one hand, this shows there is very low inbreeding in the CRIWG community, but in the other hand it also points out a lack of community building. The number of references to thesis might be interpreted as indicating a focus on exploratory rather than summative research.

4.1 Most cited references

The references most cited by CRIWG are shown in Table 8.

Table 8. Most cited references (number of citations on the left)

15	ELLIS CA, 1991, COMMUN ACM, V34, P38
12	BRIGGS RO, 2003, J MANAGE INFORM SYST, V19, P31
12	GAMMA E, 1995, DESIGN PATTERNS ELEM
10	FJERMESTAD J, 1999, J MANAGEMENT INFORMA, V15, P7
10	NUNAMAKER JF, 1991, COMMUN ACM, V34, P40
8	ROSEMAN M, 1996, ACM T COMPUTER HUMAN, V3, P66
8	SCHUCKMANN C, 1996, P ACM 1996 C COMP SU, P30
7	DOURISH P, 1992, P ACM C COMP SUPP CO, P107
7	GUERRERO LA, 2001, INFORM SOFTWARE TECH, V43, P457
7	MALONE TW, 1994, ACM COMPUT SURV, V26, P87
6	DEVREEDE GJ, 2006, INT J COMPUTER APPL, V25, P140
6	GRUDIN J, 1994, COMMUN ACM, V37, P92
6	CHABERT A, 1998, COMMUN ACM, V41, P69

4.2 Most referenced first authors

The researchers most cited by CRIWG are shown in Table 9. Only the first authors are taken into account, since ISI does not produce the full reference records.

Table 9. Most referenced authors (number of citations on the left)

50	C. Gutwin	23	L. Guerrero
46	R. Briggs	22	M. Borges
42	S. Greenberg	22	G. Stahl
35	C. Ellis	21	J. Nunamaker
34	P. Dourish	21	J. Haake
34	G. Kolfshoten	21	T. Malone
26	P. Dillenbourg	20	M. Roseman
23	D. Pinelle	20	B. Myers

4.3 Main referenced research areas

The seven categories shown in Table 10 emerged after systematic data analysis of the data set using manual search. These categories may again be categorized by order of importance, where CSCW (Computer Supported Cooperative Work) emerges as the most important research area, followed by Decision Support Systems (DSS) and Computer Supported Collaborative Learning (CSCL). It should however be noted that these categories cover a small percentage of the data set (more precisely, 25.6%). The remaining 3/4 of data could not be associated to a category.

Table 10. Main research areas referenced by CRIWG

1 – About 10%	413 (9.1%)	CSCW
2 – About 5%	238 (5.3%) 230 (5%)	DSS CSCL
3 – About 1-2%	75 (1.7%) 58 (1.2%) 105 (2.3%) 45 (1%)	Software engineering Human Computer Interaction Business Process Management Artificial Intelligence

5. Subject analysis

5.1 Research objectives

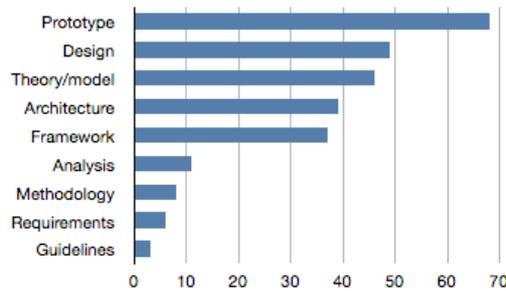


Fig. 5. Distribution of papers by research objective

As shown in Figure 5, nine different research objectives were codified during the data analysis. The most prevailing research objective is prototype development, followed by design and theory/model building. Interestingly, although a major focus is on prototyping and designing collaborative systems and tools, CRIWG has not focused on building guidelines for developers.

5.2 Research topics

The data set was manually coded with the purpose to uncover the main research topics. The coding process was done in multiple rounds for consistency. Thirty-two research topics emerged after consolidation. Figures 5 and 6 show the most and least significant topics, respectively. Learning stands out as the most prevailing research topic, considered by 51 papers (20%).

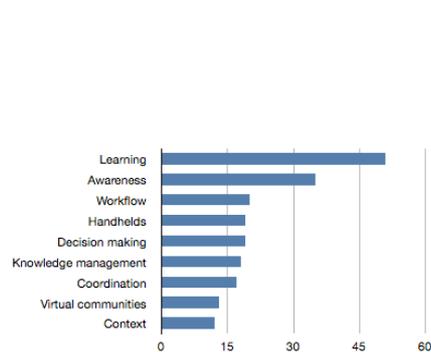


Fig. 6. Research topics (most significant)

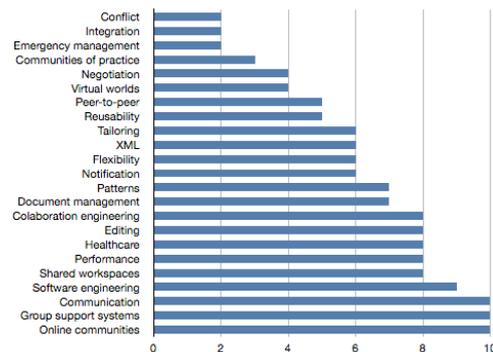


Fig. 7. Research topics (least significant)

We emphasize the coding process was performed at various conceptual levels before the main research topics were completely settled. Learning, for instance, is a

code that actually encompasses the following sub-codes: classroom activities/composition, online materials/courses, teaching, reflection, infrastructure/platform, scenarios, processes, discussion forums, modeling knowledge, interdependencies/mediation, performance, attitudes, dialectic reasoning, participation and self-organization. Awareness, in turn, includes the following sub-codes: semantic awareness, situation awareness, document awareness, awareness model, group awareness, presence awareness, workspace awareness, and change awareness.

After the coding process, the research topics were aggregated in main research areas. Five main areas emerged this way, covering the foundations of collaboration support, application areas, group decision-making, system development issues, and communities. Table 11 shows that collaboration support is the main research concern expressed by CRIWG (35% of papers). It is also interesting to note that infrastructural issues related with collaboration support have not received sizeable attention from CRIWG researchers (10% of papers).

Table 11. Main research areas

128 (35%)	Collaboration support (awareness, coordination, context, tailoring, flexibility, notification, performance, shared workspaces, communication, editing, document management)
98 (27%)	Applications areas (learning, workflow, handhelds, healthcare)
70 (19%)	Decision making (conflict, decision making, emergency management, group support systems, negotiation, knowledge management, collaboration engineering)
36 (10%)	Systems development (integration, peer-to-peer, reusability, XML, patterns, software engineering)
31 (8.5%)	Communities (virtual communities, communities of practice, virtual worlds, online communities)

5.3 Evaluation methods

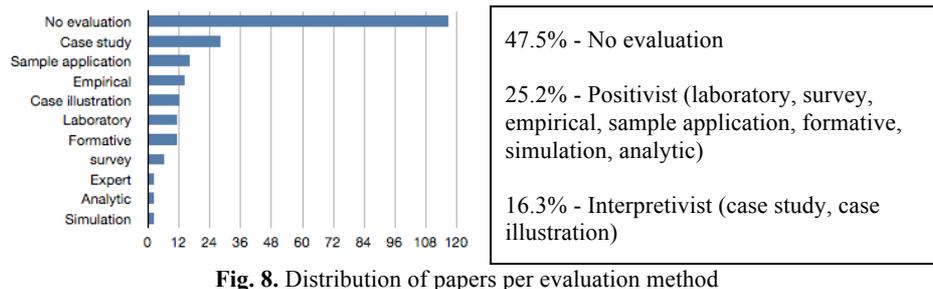


Fig. 8. Distribution of papers per evaluation method

Almost half of the papers (118 papers, 47.5%) do not present any type of evaluation. Of the adopted evaluation methods, case studies are the most prevalent one. CRIWG balances positivist and interpretivist evaluations, with a slight advance given to positivist evaluations. Interpretivism addresses questions of meaning while positivism addresses questions of cause and effect [7].

Trying to study the 118 papers without any evaluation, we found they are distributed according to Table 12.

Table 12. Subject addressed by papers without any evaluation (number of papers on the right)

Propose a framework/architecture	39
Describe a prototype	29
Concern design issues	18
Address implementation issues (e.g., flexibility, synchronization, heterogeneity, interoperability)	16
Propose a model	12
Concern workflow	3
Concern decision making	3
Concern knowledge management	2
Concern a methodology	2
Concern software engineering	3

The large number of papers with no evaluation perhaps is related to one category of papers the conference has: the Work-in-Progress class. These papers, short in length, are supposed to present initial ideas and thus may tend to be speculative, reporting initial stages of research projects. We could not confirm this hypothesis with the available data, since the proceedings do not distinguish the CRIWG type of paper.

5.4 Trends in research objectives

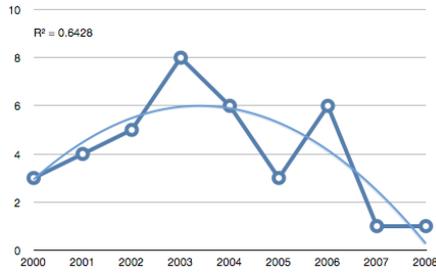


Fig. 9. Framework

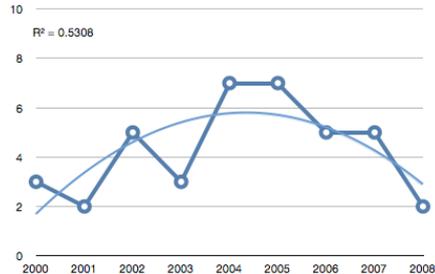


Fig. 10. Architecture

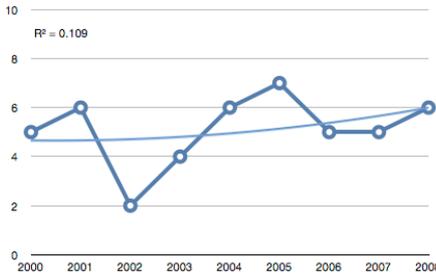


Fig. 11. Theory/models

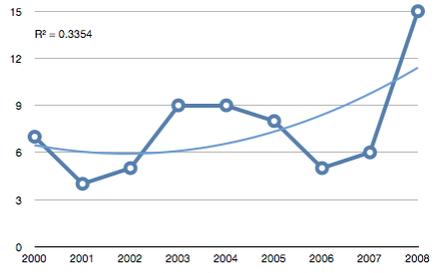


Fig. 12. Prototype

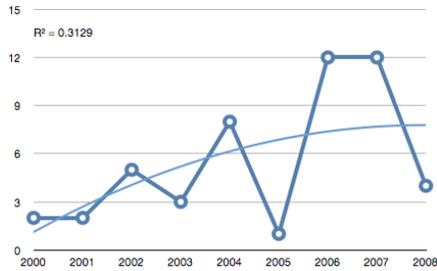


Fig. 13. Design

The trend lines shown in Figures 9-13 account the different research objectives according to year of publication. The framework and architecture topics exhibit trend lines showing that, after an increase of importance, the pursuit of these research lines is in decline (note also that R^2 is high). The other categories do not exhibit any definite trend.

5.5 Trends in research topics

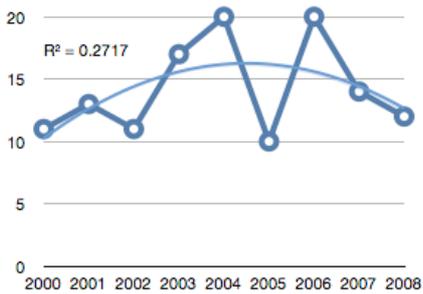


Fig. 14. Support

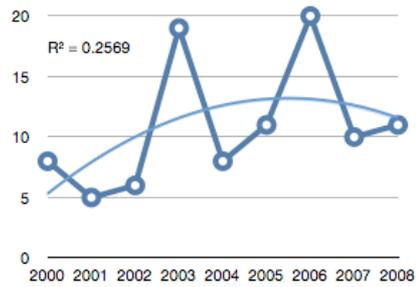


Fig. 15. Application areas

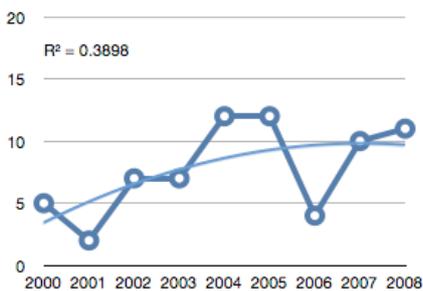


Fig. 16. Decision making

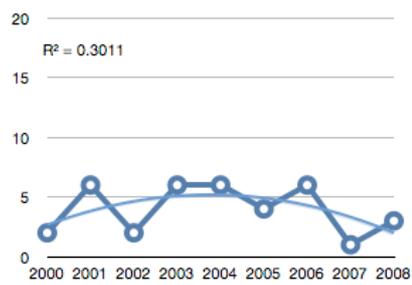


Fig. 17. Application development

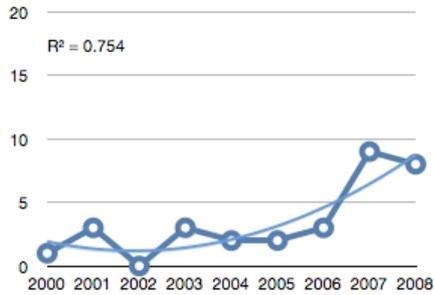


Fig. 18. Communities

The trends shown in Figures 14-18 indicate a clearly increasing interest over the communities theme (comprising issues such as virtual communities, communities of practice, virtual worlds and online communities). The CRIWG interest over application development (including various issues such as integration, peer-to-peer, reusability, XML and patterns) seems to persist as rather low when compared with the other categories.

5.6 Trend in the use of the “groupware” term

As mentioned in the Introduction, the initial goal of the Conference was to ease collaboration of researchers working in the Groupware field. We have now the feeling that groupware is being phased out in favor of other terms, including “collaborative technology”, “group support”, or more specific keywords. Figure 19 shows that the percentage of occurrences of the keyword in the proceedings of each year is declining, thus supporting our hypothesis.

The percentages were calculated using Word Counter 2.10 to scan PDF files, count words and convert PDF to text; and then using TextEdit to count how many times the groupware keyword appears in the text. To avoid counting occurrences in the papers’ references sections, we manually removed them from the PDF files.

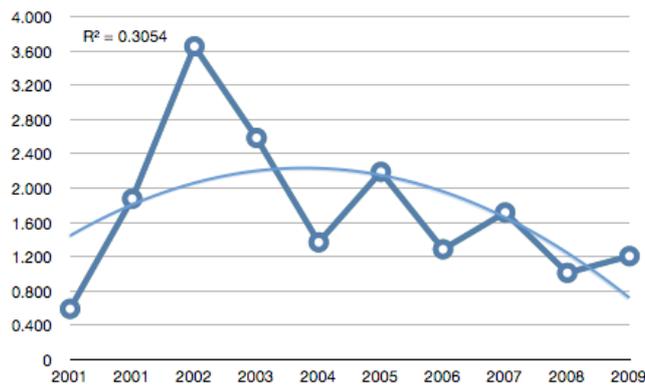


Fig. 19. Number of “groupware” words in the conference proceedings per mil

6. SWAT Analysis

A traditional Strengths/Weaknesses/Opportunities/Threats analysis is provided in Table 1. The entries are by no means definitive truths, but rather the authors' interpretations of the data elements presented above; they are subject to contrast with other viewpoints.

7. Conclusions

Several conclusions are already embedded in the SWAT analysis. However, the authors would like to emphasize a few of them.

The CRIWG conference is a well-established conference with a positive SWAT chart. Of course, weaknesses should be faced and maybe they can be corrected. Although the average number of cites received is higher than the average LNCS conference, it certainly would be desirable to raise that figure.

Table 13. SWAT analysis of CRIWG.

<p>Strengths</p> <ul style="list-style-type: none"> - Average citation index within range of other reputed conferences and above LNCS average. - More than 18% papers were extended and republished in ISI journals. - Variety of evaluation methods. - Significant focus on prototyping development and design issues. - Balance between positivistic and interpretivist evaluation methods. - High number of collaborations (currently at 57%). - Long-term agreement to publish proceedings in LNCS series. - ISI visibility. 	<p>Weaknesses</p> <ul style="list-style-type: none"> - Lack of cohesive research topics and trends. - Small focus in communities of practice (although it is increasing). - Small number of references to CRIWG papers. - Dependence on ACM conferences. - About half of the papers do not have any impact. - Small overall h-index. - About half of the papers do not address evaluation.
<p>Opportunities</p> <ul style="list-style-type: none"> - The largest number of papers comes from Brazil. This country also has a strong local conference on CSCW. A possible synergy? - Emergent application areas outside the core of the conference could be used to attract interesting papers. - Some journals already know the conference and accept special issues; it could be possible to associate the conference to a specific prestigious journal. 	<p>Threats</p> <ul style="list-style-type: none"> - Dependence on a small set of authors. - Great challenges in the field already worked out (e.g., awareness). - A relatively small number of accepted papers may not make economically viable to organize the conference in the future.

Perhaps the opportunities can be taken. The authors particularly suggest the CRIWG Steering Committee should discuss with the Brazilian members the advantages and disadvantages of organizing the conference more often in Brazil. For example, the CRIWG conference could eventually merge with the Brazilian CSCW local event; the conference could be held in Brazil and abroad in alternating years. This is especially relevant since the 2011 conference will be held in Brazil.

Another suggestion to the CRIWG conference would be to explore possibilities of long-term association with prestigious journals in the area. Finally, the incorporation of new promising research fields in areas of interest of the conference could also be considered.

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