Research Publication Trends and Topics in Computing in Civil Engineering

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ABSTRACT

This paper provides a historical perspective on computing research in civil engineering, as reflected in the *Journal of Computing in Civil Engineering (JCCE)*. The paper reports the results of a 17-year analysis of the Journal from 1987 through 2003. The main computing topical content as well as the origin and distribution of research sources and dissemination venues are summarized. The *JCCE* is intended to be of interest to researchers, professionals, and students in all civil engineering disciplines. This paper is intended to shed light on its content.

INTRODUCTION

Advances in the field of computing continue to strongly influence the civil engineering profession. Computing in civil engineering research has attracted many talented individuals who have worked and are continuing to work to advance the use of existing and emerging computing tools and techniques in civil engineering. New methods and tools are emerging from these research efforts that enable civil engineers to use computing in creative and imaginative ways. In order to realize the full potential of these advances, civil engineers must understand fundamental issues in the areas of computing education, research, and professional practice. Therefore, the goal of the *Journal of Computing in Civil Engineering [JCCE 1987-2003]*, published by the ASCE, is to serve as a resource for emerging ideas in civil engineering computing.

This paper provides a historical perspective of the Journal and reports facts and figures regarding its content. Specifically, the paper reports the results of a study of the journal, identifying:

- The main computing areas and civil engineering topics that were the focus of the published papers during the first 17 years of the journal's life.
- The main contributing organizations as well as their country of origin.
- Information about the authors and the editors of the journal.

In some cases the 17-year analysis is broken into three periods to better analyze trends over time: Period 1 is a 5 year period from 1987 through 1991, Period 2 is a 5 year period from 1992 through 1996, and Period 3 is a 7 year period from 1997 through 2003. One previous similar study was conducted to evaluate the content of the journal at its 10 year anniversary. The results of that study can be found in [Lakmazaheri and Rasdorf 1998].

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The authors believe that a review of the Journal similar to the one presented in this paper should be conducted periodically since computing concepts, issues, and capabilities are evolving, dynamic, and fast changing. The Journal's mission needs to be reviewed and assessed periodically to respond to computing challenges and opportunities and to effectively report research findings. A periodic study can contribute to this assessment and can aid in keeping the Journal's mission current. This study was dictated by need, timing, and resources and the belief that the *JCCE* was at a publishing turning point that necessitated a benchmark. We are hoping that time will bear out this expectation and that this benchmark will prove to be an important one.

BACKGROUND AND SCOPE

The *JCCE* was established in 1987 as a quarterly journal. It is one of 26 ASCE Journals. Of these, 5 are monthly, 9 are bimonthly, 10 are quarterly, and 1 is aperiodic. Over the past 6 years (1998 - 2003) the average number of papers published per year in **all** the monthly journals was 679, in the bimonthly 435, in the quarterly 189, and in the aperiodic 6. The average number of papers published per year in **each** monthly journal was 136, in the bimonthly 48, in the quarterly is 19, and in the aperiodic is 6 [ASCE 2004]. Over the same 6 year period the *JCCE*, a quarterly journal, has published 179 papers averaging about 30 papers per year, which is approximately 50% above the average. The average length of each paper published in the *JCCE* over the 2001 - 2003 period has been 10.1 printed pages.

The *JCCE* publishes technical papers, editorials, discussions, and technical notes, as do all ASCE journals. The journal covers emerging software, hardware, and strategic issues relevant to civil engineering computing education, research, and practice. The main computing areas that are considered for publication in the journal include: modeling, design, knowledge based systems, database management systems, neural networks, object oriented languages, algorithms, geographic information systems, decision support systems, optimization, scheduling, imaging techniques and simulation, robotics, data acquisition, management of computing resources, implementation strategies, and organizational impacts.

This paper presents a study of technical papers published in the journal from 1987 through 2003, in order to acquire and disseminate a general perspective on the contributors and technical content of the journal. Such a perspective should help the reader gain a better understanding of the nature and dynamics of the civil engineering computing research community and its computing research areas.

MISSION STATEMENT

The mission statement of the journal is as follows.

The Journal of Computing serves as a resource to researchers, practitioners, and students on advances and innovative ideas in computing as applicable to the engineering profession. Many such ideas emerge from recent developments in computer science, information science, computer engineering, knowledge engineering, and other technical fields. Some examples are innovations in

artificial intelligence, parallel processing, distributed computing, graphics and imaging, and information technology.

The journal publishes research, implementation, and applications in cross-disciplinary areas including software, such as new programming languages, database management systems, computer-aided design systems, and expert systems; hardware for robotics, bar coding, remote sensing, data mining and knowledge acquisition; and strategic issues such as the management of computing resources, implementation strategies, and organizational impacts.

The mission statement of the *JCCE* requires that a paper have a significant computing component to be considered for publication. Computing cannot be incidental to the paper, otherwise it is out of scope. ASCE has published discipline oriented specialty journals for many years. When the *JCCE* was created, its goal was to be cross cutting and to explore the use of computing in all of the various disciplines of civil engineering. It was not intended to draw papers (with a specialty theme or focus) away from the other journals. Instead, the *JCCE* was created to serve a unique niche and to provide "added value" to the preciously existing ASCE Publications Division specialty journals. The content of this paper will show that it has been successful in doing so.

This paper, however, will also show the reader the unrealized potential of the mission statement. In the most simplistic terms the mission statement focuses on three topics - hardware, software, and impacts of computing. We present numerous statistics to the reader that relate to mission fulfillment in the software (and modeling) area. But that is not also the case in the other two subject areas. Seldom are instrumentation, identification system, or sensor technology papers submitted to the journal. Even fewer papers that touch upon organizational or educational impacts of computers or computing are submitted. Despite the importance of these areas to civil engineers, few civil engineering researchers submit such papers to the *JCCE*.

JOURNAL CONTENT

The primary components of ASCE Journals are editorials, technical papers, technical notes, discussions and closures, and special issues.

Editorials

An editorial is a one half to 3 page opinion piece. If written by an editor or guest editor it might focus on the scope, content, direction, or philosophy of the journal. If written by a guest editor it might focus on a policy or issue concerning engineering practice or research or its application [ASCE 2000].

From 1994 to 1998 the *JCCE* launched a special initiative focusing on editorials. The goal of this initiative was to involve professionals in the production of journal technical content. This journal, as well as most other ASCE journals, has been unsuccessful at receiving technical papers from professional engineers. It was felt that timely topical editorials might attract more professional involvement.

The majority of the 1994-98 editorials (67%) were authored or co-authored by professionals in private industry. 14% were authored or co-authored by academics and 19% were authored or co-authored by government employees. Table 1 lists the authors and their affiliations as well as a complete reference for each editorial.

Over the entire 17 year period 51% of the editorials were authored or co-authored by professionals in private industry, 37% were authored or co-authored by academics, and 12% were authored or co-authored by government employees. These numbers clearly illustrate the positive effects of the editorials initiative in the 5 year period from 1994-98. When recruited to do so, professional and government authors will gladly voice their opinion through editorials. At other times academics will produce a greater percentage of editorials. This is primarily due to the fact that editorials generally introduce a special issue of the journal. For special issues an editorial is usually used to introduce the topic and the papers it contains and to highlight the contributions of each paper and to present their relationship to each other and to the topic.

During the 1994-1998 period the journal published a total of 50 editorials, averaging 10 per year or approximately 2.5 per issue. Copies of these editorials were compiled into a special publication and provide a valuable insight into perspectives and views of civil engineering computing over this period [Rasdorf 1997]. Only those editorials going back to 1995 are available on-line from the ASCE website.

Over the entire 17 year period the journal has published 71 editorials, averaging 4.2 per year or 1 per issue. Table 2 shows the frequency and distribution of editorial publication. The table clearly shows the high level of editorial activity between 1994 and 1998.

Technical Papers

The journal publishes papers that fall within the realm of its mission statement. The journal fills a unique need within the ASCE journals community, providing a publication outlet for papers that are deemed to be less discipline specific, and which make computing contributions of interest to a broader collection of civil engineering disciplines.

The number of papers published in the journal over the 17 year period totaled 467 and averaged 27.5 per year or 7 per issue. The paper distribution is shown in Table 2. In its first 5 years the average was 24.6 per year or almost 6 per issue. In the most recent 5 years the average was 31.4 or nearly 8 per issue. Thus, there is a slow but steady growth and a steady source of material is available to support the journal. The growth is such that ASCE decided to convert the journal from a quarterly to a bi-monthly in 2006.

Technical Notes

Technical notes constitute: original, practical information, preliminary or potential results of research, concisely presented research results, or innovative techniques to accomplish design objectives [ASCE 2000]. Table 2 shows that the *JCCE* publishes, on average, only 1 technical note per year. There is little difference in the publication rate for technical notes between the

first and last 5 years. Clearly, the majority of authors submit full papers to the *JCCE* rather than technical notes.

Special Issues

Special issues of the journal are produced to present a collection of papers that focus on a single topic or theme. If the number of papers on the subject does not completely fill the issue a special section is devoted to the chosen topic. Special issues or sections often originate from ASCE committee activities or from various committee members.

Table 3 identifies the special issues or sections published in the *JCCE* since its inception. There have been a total of 12 special issues or sections over the 17 year period from 1987 to 2003 averaging about 1 every 1 ½ years or one in every 6 issues. The special issues have tended to focus on topics that were of significant interest at the time. The guest editor was a strong advocate for the subject.

Two special issues were devoted to databases and data modeling. These continue to be important topics for civil engineers and are areas where the *JCCE* continues to receive papers over time. In fact, they are the most significantly constant subject areas addressed in the journal based on the number of papers submitted and published in this area.

The two special issues on European computing were highly popular and subsequently brought a number of contributions to the journal from European authors. The purpose of the two special issues was to bring developments in Europe to the attention of American researchers. Finally, two issues were also devoted to image processing. These identified numerous applications of this technology to civil engineering problems.

CONTRIBUTORS

Individual Contributors

A total of 927 different authors contributed to the Journal during its first 17 years. During period 1, approximately 15% of the authors published two or more papers. The majority (85%) of authors made a single appearance during this period. During period 2, approximately 16% of the authors published two or more papers, leaving 84% that contributed one paper during period 2. Period 3 had approximately 13% of the authors contributing to more than one paper; while 87% made only one appearance. Table 4 shows the breakdown of the 927 authors by the number of their contributions (or appearances) and by the number of times they were listed as an author regardless of the number of coauthors.

Table 4 shows that the number of appearances of authors has increased over each period. Also evident is the fact that new authors are increasingly being represented in the journal. Coupled with the growing internationalization trend these data indicate a wider authorship. Additionally, based on total appearances, more authors are becoming regular contributors.

Contributions from universities, including assistant, associate, and full professors, as well as undergraduate and graduate students and other faculty members, are shown in Figure 1. In all periods professors contributed the highest number of papers, while associate and assistant

professors generally contributed quite evenly at a slightly lower rate. Graduate and undergraduate students contributed approximately one fourth of all papers. Note that great care was taken to identify University work but that there may be some misinterpretation of the distinction between assistant, associate, and full professors outside of North America. We used the designation given by the authors.

There are 54 authors out of the 943 total (approximately 10%) who have published 3 or more papers in the *JCCE* over the 17 year period. Of them, they have been the sole authors on 19 papers (8%) and first author 95 times (40%). The total number of papers published by these authors was 235 papers out of the total of 467 published papers (approximately 50%).

Academicians were the main contributors to *JCCE* during every period. Out of 266 author appearances during Period 1 and 326 appearances during Period 2, 84% during each of these periods were by authors from academic institutions, 14% were by industry researchers, and 2% were from government authors. There was a slight change during Period 3 where, of the 503 total author appearances, 87.4% of the authors were academic contributors, 12% were from industry, and only 0.6% were from government authors. Figure 2 shows the history of author appearances from these three contributing sectors for each period. They all tell the same overall story.

Institutional Contributors

An overwhelming majority of the authors were affiliated with institutions of higher education. Table 5 lists the universities whose faculty contributed the most papers to the *JCCE*. International universities are identified in the table with an asterisk. The remainder are American Universities where the main campus is assumed unless otherwise specified. During Period 3 the most published contributor was from Nanyang Technological University in Singapore.

For each university, the adjusted number of papers is computed using the equation: $\sum_{i=1}^n 1/M$

where n is the number of papers published by a university and M is the number of contributing universities for the i th paper [Lakmazaheri and Rasdorf 1998]. For example, if two authors contributed from two different universities, then each university would receive $\frac{1}{2}$ a point for that paper. If three authors contributed to a paper, two from one university and one from another, then the first university would receive $\frac{2}{3}$ of a point while the second country would receive $\frac{1}{3}$ of a point.

Table 6 shows the industry and government agencies that contributed two or more times since the beginning of the journal. The U.S. Army was the largest contributor, making most of the total government contributions. Many industries also contributed to *JCCE*, but most only once. The few that contributed 2 or 3 times are listed in Table 6.

ASCE Affiliation

Of the total 943 contributing authors, 38% had some affiliation with the American Society of Civil Engineers while 62% of authors had no ASCE affiliation. Figure 3 shows the percentage of

authors that are affiliated with ASCE by their membership type within ASCE. As Figure 3 shows, the majority of the authors affiliated with ASCE were general members, but a large proportion were also associate members.

Best Paper Award

Beginning in 1990 the *JCCE* selected a recipient paper to be recognized as the best paper published in the journal during the calendar year. An award has been made each year since then to identify and recognize the authors of the best paper. The complete citations of the award papers are given in a section immediately following the references along with the author affiliations.

EDITORS

The editor is responsible for all journal operations and all activities affiliated with journal production. The technical editor is responsible for the technical content of the journal with a focus on technical papers, notes, discussions, and closures. Both the editor and technical editor appoint associate editors who assist in the technical paper review process as well as in the best paper award selection process.

The journal has had two editors and 5 technical editors over its life span. Mark Abkowitz of Vanderbilt University served as the original editor from January 1987 – January 1989. William Rasdorf of North Carolina State University served as editor from April 1989 to the present. The technical editors were as follows.

Mark Abkowitz	Vanderbilt University	Jan 1987 – Jan 1989	V1 N1 – V3 N1	9 Issues
William Rasdorf	North Carolina State University	April 1989 – Oct 1992	V3 N2 – V6 N4	15 Issues
Tomasz Arciszewski	George Mason University	Jan 1993 – July 1998	V7 N1 – V12 N3	23 Issues
Sivand Lakmazaheri	Catholic University	Oct 1998 – Oct 2000	V12 N4 – V14 N4	9 Issues
Hani Melhem	Kansas State University	Jan 2001 – Present	V15 N1 – P	16 Issues

INTERNATIONALIZATION

Both ASCE and its publication committees have expanded efforts aimed at greater internationalization. This section addresses this subject with respect to the *JCCE*'s authors and editors.

Authors

Researchers from 37 countries contributed to the journal between 1987 and 2003. Tables 7 and 8 identify these countries. The tables also show the number of appearances and adjusted number of papers for each country.

Table 7 shows the change for each country in the level of contribution from period 1 to period 2 and also from period 2 to 3. For each country, the adjusted number of papers is computed using

the equation: $\sum_{i=1}^n 1/M$ where n is the number of papers published by authors from that country

and M is the number of contributing countries for the i th paper [Lakmazaheri and Rasdorf 1998]. For example, if two authors contributed from two different countries, then each country would

receive $\frac{1}{2}$ a point for that paper. If three authors contributed to a paper, two from one country and one from another, the first country would receive $\frac{2}{3}$ points and the second country would be credited with $\frac{1}{3}$ point. In period 2, for example, China had 3 appearances wherein there were two papers with one Chinese author out of four and one paper with one Chinese author out of three ($0.25 + 0.25 + 0.33$). In period 3 there was one paper with one Chinese author out of four authors and one paper with one Chinese author out of three ($0.25 + 0.33$). Table 7 indicates that most of the countries increased their level of contribution from one period to the next, with the notable exception being the U.S. Recall that periods 1 and 2 span 5 years while period 3 spans 7 years. In table 7 countries with two or more appearances are shown. While some countries with only a single appearance are not shown in Table 7 those countries are shown in Table 8 if their total appearances is two or more papers.

Figure 4 shows the increase in the level of international authors over the total period. While only an average of 20% of the papers from Period 1 were written by international authors, this number increased to 40% during Period 2. Period 3 shows a dramatic additional increase, with international authors presently contributing to more than half, or 50% of the papers. Overall, there have been approximately 60% U.S. and 40% international authors by distribution.

One might question the reasons for the relatively "flat" trends in U.S. authorship and *JCCE* publications. It may be the case that the community of researchers in computing in civil engineering has remained limited in size. That is, despite having assumed a permanent role in civil engineering, perhaps computing has grown to its mature size in terms of the civil engineering research community and the profession's needs. Furthermore it is often the case that young faculty publish in more traditional discipline oriented journals to gain a tenure track record. That is, other journals may receive many papers that could be published in the *JCCE* but are sent elsewhere by choice.

Table 9, which summarizes the international activity by regional contribution to the journal, is also interesting. The table shows that historically 69% of all *JCCE* papers have originated in North America (60% U.S., 9% Canada). For the *JCCE* 17% of all papers originated from Asia and 3% from Europe. Separate data from ASCE presented at the 2003 Editor's Annual workshop for 2003 shows that the breakdown for all submissions to all ASCE journals consisted of 47% from North America, 35% from Asia, 16% from Europe, and 1% each from Africa and South America. The overall *JCCE* trend is significantly more domestic than what ASCE is seeing today with regard to overall paper origin. But still, it is quite international with the majority of the international growth coming from Asian countries.

Associate Editors

The *JCCE* continues to support ASCE's internationalization efforts, in part by striving to establish a global editorial board. Of the 13 associate editors (at the end of 2003) 5 are from countries outside of the U.S. as noted below.

M. C. Deo	India	Indian Institute of Technology
Hugues Rivard	Canada	ETS
Simeon Simoff	Australia	University of Technology
John Miles	United Kingdom	Cardiff University
Chee-Kiong Soh	Singapore	Nanyang Technological University

This globalization will continue to benefit both ASCE and the *JCCE* in at least two ways. First, it provides the day to day help needed to conduct the important and critical paper review process work of the journal. Second, it extends journal exposure to other countries through a direct contact at a prominent University.

TECHNICAL TOPICS

To determine the subject areas addressed by the journal each published paper was classified based on the area or topic in which it makes its main computing contribution. Although the theme of some papers may fall into many different computing areas, only three main topics of each were used to classify each paper. Overall there have been about 354 main topics of papers published in the *JCCE*. Tables 10 and 11 show the topics with the most appearances for each of the three periods and cumulatively.

A review of the compiled data for all three periods reveals that papers related to expert systems and design (the two top topics during Period 1) had a significant decrease in number published over time. From Period 1 to Period 2 they went from 1st and 2nd place, with 27 and 15 papers respectively, to 3rd and 5th place during Period 2 with only 14 and 12 papers each. During Period 3 they did not even rank on the chart. The largest increase in paper topics was in Neural Networks. Not even one paper was related to neural networks during Period 1, but it became one of the most published topics for both the 2nd and 3rd periods, increasing to 23 and to 27 papers, respectively. This occurred despite exercising editorial care not to publish neural network papers that did not demonstrate advances or significant contributions.

Period 3 of Table 10 is reflective of the topical content of the *JCCE* at present. Clearly, neural network papers have captured the interest of researchers and authors in computing in civil engineering. Another topic worthy of note is modeling. Of all topics addressed by civil engineering computing researchers this is one that is broadly applicable and that has been timelessly of interest to the journal's readers over its lifespan. One observation that emerges from the material published in the journal is the need for the civil engineer to fully understand new problems and situations and to be able to express the physical realm in which he operates. This requires modeling. It is the most persistent topic in the journal. Table 11 shows the historical topical content for the overall 17 year period.

STATISTICAL MEASURES

The *JCCE* editors strive to establish a high level of quality for the *JCCE*. Both the acceptance rate and the impact factor are statistics which seem to indicate that these efforts are having a positive effect.

Impact Factor

Impact factor is a measure that is rising in importance for journals. Impact factor is a measure of the frequency with which the "average article" in a journal has been cited over a period of time. In particular, it is a function of the number of times a given journal has been cited in the past two years. The impact factors for the *JCCE* over the past few years, as provided by the ASCE Publications Division [ASCE 2004], are as follows.

2003	0.682
2002	0.500
2001	0.627
2000	0.375
1999	0.414
Average	0.517

For 2003 the ASCE journal with the highest impact factor (Composites) had a value of 1.234. The *JCCE* was the 6th highest rated ASCE journal. Ahead of it in ASCE were the 4 "wet" journals (Hydraulics, Environmental, Waterways, and Water Resources). The *JCCE* also was ranked 16th out of a total of 73 civil engineering journals of all types in 2003 with respect to impact factor [ASCE 2004].

Acceptance Rates

Acceptance rate is another important journal statistic that is maintained by ASCE. From 1991 through 2004, a period encompassing 14 years, the average acceptance rate for the *JCCE* was 47% [ASCE 2004]. No other journal (total of 30 journals) published by ASCE had a lower acceptance rate during this period. One other, Water Resources, had the same acceptance rate level as the *JCCE*. Although one cannot read too much into this number, the low acceptance rate implies the application of a rigorous review standard and is very often very positively viewed.

One factor which may have an affect on the acceptance rate is the mission statement of the journal. Authors often misunderstand the mission statement and submit discipline oriented papers to the *JCCE* which belong, more appropriately, in a specialty journal. Such papers must then be rejected and rerouted to other journals. The most typical of these are papers in the areas of numerical analysis, simulation, and finite element analysis.

Another factor affecting the acceptance rate is the submission of neural network papers. We have already discussed their profusion in the journal as it has been published. However, unmentioned has been the fact that far more neural network papers resubmitted than are papers of any other subject area. Most of these deal with insignificant problems and case studies and they continuously redefine what a neural network is, thus replicating the content of papers published as far back as a decade ago. Most of these papers lack substance and archival contribution and are rejected. This does not occur in any other subject area addressed by the journal.

SURVEY FINDINGS ABOUT COMPUTING EDUCATION

The goal of a survey that was recently conducted by ASCE's Task Committee on Computing Education of the Technical Council on Computing and Information Technology was to identify the computing skills needed by undergraduate civil engineering students as perceived by academicians and practitioners and to assess the students' competence in using those computing tools or mastering those computing subjects or topics [Abudayyeh 2004]. The educator's survey focused on determining the importance, competence, and coverage of various computing skills, while the practitioner's survey focused on the frequency of use of a skill or a tool, in addition to

importance and competence. In brief, the educator's survey focused on what should be taught to students while the practitioner's survey focused on both the need for skills and knowledge as well as the competence of graduates in those areas.

Many similarities were found between educators and practitioners with respect to the importance and competence categories. For instance, in the category of the most important computer skills obtained by civil engineering undergraduates, both parties agreed that spreadsheet, word processor, and Computer Aided Design (CAD) knowledge were of great utility and therefore was important skills. It was also agreed that presentation packages such as Power Point were useful. Obviously, spreadsheets, word processors, and presentation packages were not addressed in most technical papers published in *JCCE* since these are tools that might be used in research studies but are not usually publication topics in and of themselves. On the other hand, topics such as CAD, computer software, and electronic communications were addressed in various papers published in the Journal.

It is interesting to note that a number of computing topics were ranked near the bottom of the list of importance and competence in both surveys, while they were often discussed and reported on in technical papers in the *JCCE*. For instance, the number of published *JCCE* papers dealing with geographic information systems is rising, while both surveys listed it in the lower middle rank as far as importance and competence. Neural network papers, which were mentioned earlier, also fall in this category while they received low rankings in the survey they are the most published topic in the *JCCE*.

However, publication trends do not always disagree with the surveys. For example, one frequently discussed topic in the Journal was expert systems. In the analysis of research trends in the *JCCE*, expert systems was the most discussed topic during the period 1, it fell to 3rd place in period 2, and it was not even in the top 10 topics by period 3. This downward trend was also clear in both surveys, where expert systems were ranked last or second to last in every category of both surveys. Thus, research trends evolve as does the subject matter dealt with in the journal. In the case of expert systems their value was not persistent over time.

What the two surveys have shown is what is being taught to students and whether it is mastered (or not). In them there is a definite focus on skills. As far as subject matter is concerned (topics), there appears to be a significant disconnect between publication topics and educational subjects. This warrants the community's attention. Neural networks, for example are frequently studied by civil engineering researchers but are of little interest to teaching faculty, undergraduate students, or employers. Other topics like fuzzy sets, object oriented languages, decision support systems, and genetic algorithms would also fall into this categorization as well. A few favored survey topics, including algorithms, simulation, design, optimization, and scheduling generally maintain at least a place in the curriculum.

SUMMARY AND CONCLUDING REMARKS

From the beginning of 1987 through the end of 2003 there were 943 total authors who contributed 478 total technical papers to the *JCCE*. Academicians were the largest contributors of technical papers. About 38% of contributing authors were members of ASCE. In terms of regions, the United States was the largest contributor of papers (60%), but international

contributions are rising rapidly (40%). The most discussed topics for Period 3, which is most reflective of the present day, were neural networks, algorithms, fuzzy sets, and modeling. These topics are most frequently seen in research proposals and heard in technical presentations. Of these, neural networks are unique in that they are falling out of favor with educators and professionals, but not with researchers.

Contributions to the *JCCE* are increasing. Both author and topical diversity are present. A special issue focusing on a topic of current interest is published once a year on average. Authors are reluctant to publish discussions and closures, as they are with most ASCE journals. Its citation index and acceptance rate are positively positioned for long term health.

It is clear from the trends observed in this study that *JCCE*'s readership and authorship have changed significantly over time. This is particularly evident from the increase in international contributions over the 17-year life of the Journal. However, U.S. authors continue to be the main contributors to the journal. But the trends seen in the analysis suggest that the world is catching up at a significant pace. A more concrete conclusion in this regard can only be reached after similar studies are conducted on other journals that share a similar mission with *JCCE*.

Furthermore, the Journal has always been a premier medium for exchange of ideas among researchers. This is clear from the change in topical content over time to reflect the evolution of computing in civil engineering research. The Journal is dynamic and has always addressed state-of-the-art computing issues and technologies.

REFERENCES

ASCE. (2000). "*Authors' Guide to Journals and Practice Periodicals.*" American Society of Civil Engineers, Reston, VA.

ASCE. (2004) "*Editors Workshop.*" American Society of Civil Engineers, Baltimore, MD, October 23.

JCCE. (1987-2003). Journal of Computing in Civil Engineering, American Society of Civil Engineers, 1(1) through 17(4).

Lakmazaheri, S. and W. Rasdorf. (1998). "*Foundations for Research in Computing in Civil Engineering.*" Journal of Computing in Civil Engineering, American Society of Civil Engineers, 12(1), 9-18, January.

Abudayyeh, O., Cai, H., Fenves, S. J., Law, K., O'Neill, R., and Rasdorf, W. (2004). "*An Assessment of Computing Needs in Civil Engineering Education.*" Journal of Computing in Civil Engineering, American Society of Civil Engineers, 18(3), 187-195, July.

Rasdorf, W. (1997). "*Journal of Computing in Civil Engineering: Editorials.*" Technical Report, Department of Civil Engineering, North Carolina State University, Raleigh, NC, January.

BEST PAPER AWARD RECIPIENTS

Fenves, S., Baker, N. (1990). “*Manipulating Shape and Its Function.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 4(3), 221-238, July. [Carnegie Mellon University, Georgia Tech]

Davidson, J., Goulter, I. (1991). “*Rule-Based Design of Layout of Rural natural Gas Networks.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 5(3), 300-314, July. [University College of Central Queensland]

Phan, D., Howard, C., Abdalla, J. (1992). “*A Primitive-Composite Approach for Structural Data Modeling.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 6(1), 19-40, January. [Stanford University]

Adams, T., Tang, A., Weigand, N. (1993). “*Spatial Data Modeling for Managing Subsurface Data.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 7(3), 260-277, July. [University of Wisconsin]

Morad, A., Beliveau, Y. (1994). “*Geometric-Based Reasoning System for Project Planning.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 8(1), 52-71, January. [Florida International University, Virginia Tech]

Pena-Mora, F., Logcher, R., Sriram, D. (1995). “*Design Rationale for Computer-Supported Conflict Mitigation.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 9(1), 57-72, January. [Massachusetts Institute of Technology, National Institute of Standards and Technology]

Soh, C. K., Yang, J. (1996). “*Fuzzy Controlled Genetic Algorithm Search for Shape Optimization.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 10(2), 143-150, April. [Nanyang Technological University]

de la Garza, J., Alcantara, Jr., P. (1997). “*Using Parameter Dependency Network to Represent Design Rationale.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 11(2), 102-112, April. [Virginia Tech]

Han, C. S., Kunz, J. C., Law, K. H. (1998). “*Client/Server Framework for On-Line Building Code Checking.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 12(4), 181-194, October. [Stanford University]

Gangopadhyaya, S., Gautam, T. R., Gupta, A. D. (1999). “*Subsurface Characterization Using Artificial Neural Network and GIS.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 13(3), 153-161, July. [Asian Institute of Technology]

Sziveri, J., Topping, B. H. V. (2000). “*Transient Dynamic Nonlinear Analysis Using MIMD Computer Architectures.*” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 14(2), 79-91, April. [Heriot-Watt University]

Kiliccote, H., Garrett, Jr., J. H. (2001). “*Standards Usage Language (SUL)*.” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 15(2), 118-128, April. [Carnegie Mellon University]

Akinci, B., Fischer, M., Levitt, R., Carlson, R. (2002). “*Formalization and Automation of Time--Space Conflict Analysis*.” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 16(2), 124-134, April. [Carnegie Mellon University, Stanford University]

Domer, B., Raphael, B., Shea, K., Smith, I. F. C. (2003). “*A Study of Two Stochastic Search Methods for Structural Control*.” Journal of Computing in Civil Engineering, American Society of Civil Engineers, 17(3), 132-141, July. [Swiss Structural Engineering Institute]

Figure 1. University Contributors

Figure 2: Author Affiliations

Figure 3: ASCE Contributors

Figure 4. Appearance Comparison for National and International Authors

Vol	Num	Year	Month	Author	Affiliation	I, U, G
1	4	1987	October	Richard N. Palmer	University of Washington	U
4	3	1990	July	Nadim M. Aziz	Clemson University	U
4	4	1990	October	Paul Teicholz	Stanford University	U
				C. William Ibbs	University of California	U
5	1	1991	January	James H. Garrett Jr.	Carnegie Mellon University	U
				Mary Lou Maher	University of Sydney	U
5	2	1991	April	Charles H. Thornton	ASCE	I
				Emmanuel E. Velivasakis	ASCE	I
5	3	1991	July	Jon C. Liebman	University of Illinois	U
5	4	1991	October	Krishnan Gowri	SIRICON	I
				Claude Bedard	Concordia University	U
				Paul Fazio	Concordia University	U
6	1	1992	January	C. William Ibbs	University of California	U
6	2	1992	April	A. B. Cleveland Jr.	Jacobus Technology	I
6	3	1992	July	Gregory L. Fenves	University of California at Berkeley	U
6	4	1992	October	Kent A. Reed	NIST	G
7	1	1993	January	Charles Eastman	Georgia Institute of Technology	U
7	2	1993	April	Daniel Horn	ECOM Associates	I
7	3	1993	July	Jeff R. Wright	Purdue University	U
7	4	1993	October	Timothy S. Killen	Bechtel Corporation	I
7	4	1993	October	Bill Mazilly	Fluor Daniel Corporation	I
7	4	1993	October	Kenneth F. Reinschmidt	Advanced Systems Development Services	I
8	2	1994	April	James H. Garrett Jr.	Carnegie Mellon University	U
8	4	1994	October	Lauri Koskela	VTT Technical Research Center	U
				Bo-Christer Bjork	Royal Institute of Technology	U
9	2	1995	April	James G. Jacobi	Brown & Root	I
9	3	1995	July	Robert W. Mooney	Thomas Associates	I
9	4	1995	October	Charles S. Hodge	Boyle Engineering Corporation	I
10	1	1996	January	John G. Voeller	Black & Veatch	I
10	1	1996	January	Paul Scarponcini	Graphic Data Systems Corporation	I
10	2	1996	April	John Lynch	Autodesk	I
10	2	1996	April	Glenn S. Orenstein	Stone & Webster Engineering Corporation	I
10	4	1996	October	John P. Menniti	STV Incorporated	I
10	4	1996	October	James D. Miller	Sverdrup Facilities	I
10	4	1996	October	Michael J. Vecchietti	Federal Highway Administration	G
				Lawrence I. Neff	Federal Highway Administration	G

TABLE 1. Editorials

Vol	Num	Year	Month	Author	Affiliation	I, U, G
11	1	1997	January	Ken Herold	International Alliance for Interoperability	I
11	1	1997	January	James R. Ahart	APEC	I
11	1	1997	January	Pepi Edlinger	Bechtel Corporation	I
11	2	1997	April	Scott Bentley	Bentley Systems	I
11	2	1997	April	Dana K. Smith	Naval Facilities Engineering Command	G
11	3	1997	July	J. Mark Andersen	Environmental Systems Design	I
11	3	1997	July	M. Kevin Parfitt	Pennsylvania State University	U
11	3	1997	July	Osama Abudayyeh	Western Michigan University	U
11	4	1997	October	Glenn R. Bell	Simpson Gumpertz & Heger	I
11	4	1997	October	Michael Hough	A/E/C SYSTEMS International	I
12	1	1998	January	David A. Holdstock	Institute for Transportation Research and Education	G
12	1	1998	January	Dean Bowman	GEOPAK Corporation	I
12	1	1998	January	Loren R. Risch	Kansas Department of Transportation	G
12	2	1998	April	Michael J. O'Conner William Rasdorf	US Army, Civil Engineering Research Laboratory North Carolina State University	G U
12	2	1998	April	Don Kiel Jon Pollack Minhua Wang	Geo Decisions Geo Decisions Geo Decisions	I I I
12	2	1998	April	Evan Reis	Degenkolb Engineers	I
12	3	1998	July	Jack Dangermond Adena Schutzberg	ESRI ESRI	I I
12	3	1998	July	Ram D. Sriram	NIST	G
12	3	1998	July	Hassan A. Karimi	North Carolina Supercomputing Center	I
12	4	1998	October	Douglas J. Peters	Applied Research Associates	I
12	4	1998	October	Satinder P. S. Puri	Consulting Structural Engineer	I
12	4	1998	October	R. J. Kratky	Weidlinger Associates	I
12	4	1998	October	Y. Henry Huang	Los Angeles County Public Works Department	G
12	4	1998	October	Jason P. Heroux	Simpson Gumpertz & Heger	I
12	4	1998	October	L. Allen Adams	Ram International, LLC	I
13	2	1999	April	J. David Frost	Georgia Institute of Technology	U
15	1	2001	January	Yung-Ching Shen Lisa K. Spainhour	Siena College Florida A&M University - FSU	U U
16	4	2002	October	Hojjat Adeli	Ohio State University	U
17	3	2003	July	Lynne Moore John Miles	Cardiff University Cardiff University	U U
18	1	2004	January	Eyad Masad Krishna Sivakumar	Texas A&M University Washington State University	U U

I denotes Industry, U denotes University, G denotes Government

TABLE 1. Editorials (continued)

Year	Editorials	Discussions and Closures	Technical Papers	Technical Notes
1987	1	0	23	1
1988	1	0	24	1
1989	0	3	25	0
1990	2	0	25	0
1991	4	0	26	1
1992	4	0	29	0
1993	4	0	28	1
1994	13	4	21	2
1995	3	5	28	0
1996	9	1	33	3
1997	10	6	26	3
1998	15	3	22	0
1999	1	3	32	2
2000	0	0	32	1
2001	2	0	36	1
2002	1	0	28	1
2003	1	4	29	1
Total	71	29	467	18
Average	4.2	1.7	27.5	1.1

TABLE 2. Technical Content of the *JCCE*

Month	Year	Vol	No.	Title	No. of Papers	Type	Guest Editor	Affiliation
Oct	1987	1	4	Expert Systems in Civil Engineering	8	Issue	Richard Palmer	University of Washington
July	1990	4	3	Computational Geometry	3	Section	Nadim Aziz	Clemson University
Jan	1991	5	1	Expert Systems in Planning and Design	4	Section	James Garrett Mary Maher	University of Illinois University of Sydney
Jan	1992	6	1	Databases	6	Issue	William Ibbs	University of California, Berkeley
July	1992	6	3	Object Oriented Systems	7	Issue	Gregory Fenves	University of California, Berkeley
July	1993	7	3	Geographic Information Analysis	8	Issue	Jeff Wright	Purdue University
April	1994	8	2	Neural Networks	8	Issue	James Garrett	Carnegie Mellon University
Oct	1994	8	4	European Computing	9	Issue	Lauri Koskela Bo-Christer Bjork	Technical Research Centre of Finland
July	1996	10	3	Data, Product, and Process Modeling	6	Section	Kincho Law	Stanford University
April	1999	13	2	Imaging Technologies in Civil and Environmental Engineering	9	Issue	David Frost	Georgia Institute of Technology
Jan	2001	15	1	Information Technology for Life Cycle Infrastructure Management	9	Issue	Yung-Ching Shen	Siena College
July	2003	17	3	Research on Intelligent Computing in Europe	7	Section	Lynne Moore John Miles	Cardiff University

TABLE 3. Special Issues

Number of Appearances	Authors		Total Appearances
	Number	Percentage	
Period 1 (1987-1991)			
1	188	84.9%	188
2	24	11%	48
3	7	3.2%	21
4	1	0.5%	4
5	1	0.5%	5
6	0	0%	0
[Total]	221	100%	266
Period 2 (1992-1996)			
1	231	83.9%	231
2	37	13.5%	74
3	7	2.6%	21
4	0	0%	0
5	0	0%	0
6	0	0%	0
[Total]	275	100%	326
Period 3 (1997-2003)			
1	380	88.1%	380
2	40	9.3%	80
3	5	1.2%	15
4	3	0.7%	12
5	2	0.4%	10
6	1	0.2%	6
[Total]	431	100%	503
17 Year Period [Total]	927		1095

TABLE 4. Number of Authors and Author Appearances

Institution	Number of Appearances *	Adjusted Number of Papers
Stanford University	23	17.04
North Carolina State University	23	14.56
Carnegie Mellon University	19	13.28
Purdue University	18	12.58
Massachusetts Institute of Technology	16	11.9
University of Maryland	15	11.62
Nanyang Technological University*	12	9.25
University of Wisconsin at Madison	12	9.16
University of Colorado	11	8.5
Georgia Institute of Technology	11	7.75
Concordia University*	8	6.33
University of Manitoba*	8	6.33
University of Texas at Austin	7	6.25
University of Illinois at Urbana Champaign	6	5.33
Ohio State University	5	5
University of California at Berkeley	9	4.89
Pennsylvania State University	6	4.66
Rensselaer Polytechnic Institute	6	4.66
Virginia Tech.	7	4.4
Illinois Institute of Technology	6	4.16
University of Alberta*	5	4
Indian Institute Of Technology*	5	3.16
Utah State University	5	3

- Only institutes with 5 or more appearances are shown.

TABLE 5. Main University Contributors Over the 17 Year Period (1987-2003)

Government/Industry	Number of Papers *
U.S. Army	9
NASA Research Center	4
Kachina Technologies	3
Bechtel Western Power Corp.	2
CTI Engineering	2
Civil Engineering Research Center	2
PCL Industrial Constructors	2
South Florida Water Mgmt.	2
Stone & Webster Corp.	2

- * Only organizations with 2 or more appearances are shown.

TABLE 6. Main Government and Industry Contributors Over the 17 Year Period (1987-2003)

Country	Number of Appearances	Adjusted Number of Papers
Period 1 (1987-1991)		
United States	105	101.25
Canada	12	11
India	4	3.33
England	3	3
Period 2 (1992-1996)		
United States	99	91.25
Canada	13	10.83
England	8	6.33
Australia	6	5
Taiwan	5	4
India	4	3.5
Israel	4	3.25
Singapore	4	3
Japan	4	2.83
The Netherlands	2	2
Poland	2	2
Sweden	2	2
Morocco	2	1.16
China	3	0.83
Period 3 (1997-2003)		
United States	107	99.07
Canada	21	19.5
England	13	11.16
Singapore	12	9.25
Taiwan	9	8.33
Australia	7	7
Korea	6	4.66
Hong Kong	6	4
India	5	3.83
Egypt	3	3
Israel	4	2.83
Japan	3	2.5
Saudi Arabia	2	2
Scotland	2	2
Switzerland	2	2
Thailand	2	1.33
China	2	0.58

TABLE 7. Country of Origin of Contributing Authors by Period

Country	Number of Appearances	Adjusted Number of Papers
United States	311	291.57
Canada	46	41.33
England	24	20.49
Singapore	17	13.25
Australia	14	13
Taiwan	15	12.83
India	13	10.66
Israel	9	6.56
Japan	7	5.33
Korea	6	4.66
Hong Kong	6	4
Egypt	3	3
Switzerland	3	3
The Netherlands	3	3
Saudi Arabia	3	2.5
Poland	3	2.5
Scotland	2	2
Sweden	2	2
China	5	1.41
Thailand	2	1.33
Germany	2	1.25
Morocco	2	1.16

TABLE 8. Home Country of Origin of Contributing Authors Over the 17 Year Period (1987-2003)

Region	Number of Appearances	% of Appearances	Adjusted Number of Papers
North America	357	69	332.9
Asia	88	17	65.61
Europe	46	9	39.4
Australia	16	3	14.33
Africa	8	2	5.91

TABLE 9. Regional Contributions Over the 17 Year Period (1987-2003)

Topic	Number of Papers
Period 1 (1987-1991)	
Expert Systems	27
Design	15
Knowledge Based Systems	14
Automation	13
Computer Programs	11
Microcomputers	11
Modeling	9
Structural Design	9
Computer Software	8
Simulation	8
Period 2 (1992-1996)	
Modeling	31
Neural Networks	23
Expert Systems	14
Object Oriented Languages	13
Design	12
Computer Software	10
Simulation	10
Algorithms	9
Geographic Information Systems	8
Period 3 (1997-2003)	
Neural Networks	27
Algorithms	15
Fuzzy Sets	11
Modeling	11
Imaging Techniques	10
Optimization	9
Geographic Information Systems	8
Decision Support Systems	7
Scheduling	7
Computer Software	6

TABLE 10. Topical Journal Content by Period

Topic	Number of Papers
Modeling	51
Neural Networks	50
Expert systems	46
Design	34
Algorithms	31
Knowledge Based Systems	28
Simulation	26
Computer Software	24
Computer programs	19
Automation	18
Optimization	17
Geographic Information Systems	16
Structural Design	16
Decision Support Systems	15
Scheduling	15
Object Oriented Languages	13
Fuzzy Sets	13
Microcomputers	12
Imaging Techniques	10

TABLE 11. Topical Journal Content for the 17 Year Period (1987-2003)