CAADRIA 2002

Proceedings of the 7th International Conference on Computer Aided Architectural Design Research in Asia

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Hosted By

Faculty of Creative Multimedia, Multimedia University, Malaysia

www.mmu.edu.my

Co-Hosted By

Teknion Furniture Systems (Malaysia) Sdn. Bhd.

www.teknion.com

18 – 20 April, 2002

New York London Toronto Sydney Mexico City Singapore Kuala Lumpur

Published By

Prentice Hall
Pearson Malaysia Sdn. Bhd.
(Formerly known as Pearson Education Malaysia Sdn. Bhd.)
Lot 2, Jalan 215, Off Jalan Templer,
46050 Petaling Jaya,
Selangor, Malaysia
Tel: 03-77820466 Fax: 03-77853435

Pearson Education offices in Asia: *Bangkok, Beijing, Hong Kong, Jakarta, Manila, Kuala Lumpur, New Delhi, Seoul, Singapore, Taipei, Tokyo.*

Printed in Malaysia
ISBN: 983-2473-42-X

5 4 3 2 1
06 05 04 03 02

Cover Design & Concept: *Che Ahmad Azhar Fadzil, Fauzan Haji Mustaffa, Ramlan Saad, Erwin Abdul Jabbar*

International Conference on Computer Aided Architectural Design Research in Asia (CAADRIA 2002)

Host: Faculty of Creative Multimedia, Multimedia University, Malaysia
Co-Host/Main Sponsor: Teknion Furniture Systems (Malaysia) Sdn. Bhd.

DIGITAL CAADRIA-PROCEEDINGS: RETROSPECTIVE ANALYSIS OF CONTENT

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Abstract. This contribution issues an overview of the frame conditions for the utilization of Digital CAADRIA Proceedings representing in its entirety an important asset for the CAAD-community. The process of the extended use of electronic copies of CAADRIA conference papers in pdf-format is described as well as the respective decisions taken in this context. Results of a content analysis regarding the topics of CAAD and referencing are presented.

1. Background

Annual conference activities of CAADRIA started in 1996 with an initial output of 31 full papers, published on 316 pages. Since 1997 the number of papers has steadily increased to approx. fifty at present. In the framework of these conference proceedings, all in all 285 papers were created amounting to a publication output of 2.775 pages for the period 1996-2001. CAADRIA is a lively association and the knowledge-base is expanding from year to year. Therefore, it is of interest to which extent this information has become accessible and has been analyzed as to substance matter. So far, CAADRIA has been focusing on paper-based proceedings. Generally spoken, smaller editions of such proceedings seem to be safely stored away in the studies of faculty members, but hardly become widely available to the (scientific) public. A wise decision was taken by the CAADRIA-board to reproduce previous conference proceedings in pdf-format and thus enhance the potential of wide access at low cost. Most of the material was archived in

digital format and could therefore be converted easily without the necessity of scanning paper-based materials and performing optical character recognition (ocr).

2. Concept of On-line Access: CUMINCAD

In fall 2001 all CAADRIA proceedings were reproduced in pdf-format, aiming, however, at presenting the original layout, traced back to the original proceedings. Wishing to be able to create the best-possible match of the original, the alternative i.e. html-documents was not pursued, as problems with page breaks etc. may occur. Though most of the pdf-documents were directly reproduced from the original program documents the annual volumes 1996 and 1997 had to be scanned in as digital specimens were not available.

Having made these materials available in a digital format and thus potentially enabling enhancement of accessibility, the framework for extended use has to be specified. E.g. a complete indexed file for off-line use (CD-ROM) could easily be created, but respective decisions have to be taken by the CAADRIA-board. In the framework of this paper the on-line use will be focused on, i.e. a collection of stand-alone pdf-files in connection with the CUMINCAD-database (http://itc.fgg.uni-lj.si/cumincad/). CUMINCAD, an acronym for "Cumulative Index on CAD", is a bibliographic index compiling papers related to Computer Aided Architectural Design (Martens and Turk, 1999). This work started in 1998 on a shoestring budget and helps focusing on future CAAD education and research activities. Implemented with a database, it allows searching and browsing in the ways usual on the Web. It provides a "historical evolution" to learn from previous efforts and draws attention to older original works that could have been ignored because they could not be found otherwise. CUMINCAD thus supports free of charge the search and the dissemination of CAAD-related publications. Presently, all major CAAD conference proceedings (ACADIA, CAAD futures, CAADRIA, eCAADe, SiGraDi) are recorded in CUMINCAD. If, however, a record is of interest, it might be rather difficult to retrieve the corresponding full paper and then it seems useful to retrieve the pdf-paper immediately without delay.

The result of digitization should not be treated as just another collection of papers; e.g. an overview of the knowledge-base could be created (Martens, Turk and Cerovsek, 2001). This way also the authorship can count on improvements regarding dissemination of their publications. CAADRIA, furthermore, has a relatively large number of papers from PhD-students whose access to "free electronic publications" seems to be of particular importance in terms of full papers to be retrieved at hardly any costs (Tenopir and King, 2000). Due to the current CUMINCAD-policy three

stages of availability are provided. *Anonymous access* only provides access to bibliographic data, however. E-mail address entry makes the user a "*friend*" also having access to the summaries. At present *full access* is only available to eCAADe- and CAADRIA-members and grants access to stored pdf-documents (at the time of writing approx. 800 papers). Digitization of SiGraDi proceedings has been scheduled for the first half and of ACADIA proceedings for the second half of 2002.

3. Objectives and Results Concerning Analysis of Content

Ontology of a scientific field typically includes a taxonomy that breaks up the field into several topics. The taxonomy is e.g. implicitly present in the organization of conference proceedings. In the framework of a conference paper which was focusing on the machine's perspective regarding the topics of CAAD (Turk, Cerovsek and Martens, 2001) efforts to use the machine learning and data mining techniques to automatically group papers into clusters and to create a set of keywords labeling a cluster were presented. The hypothesis was that an algorithm would create clusters of papers automatically and that the clusters would be similar to the groupings a human would have made. Several algorithms for performing such an analysis like that were investigated, but the researchers were unable to prove the original hypothesis. The main conclusion consequently stated that it requires more than objective statistical analysis of the words in abstracts to create ontology of CAAD.

For this reason "human expertise" expressed in previous *calls for papers* (so called "topics of interest") as well as the *session labels* from previous CAADRIA conferences in the period 1996-2001 were collected. The alphabetical list of topics including more than one hundred entries was compressed for reasons of better accessibility into less than a third of the original length. Similar or identical terms were thus pooled and the number of quotations was added in brackets. Subsequent conference chairs naturally will look into the papers of the previous events. Major changes are to be registered particularly concerning the first CAADRIA conference and the following conferences, a fact readily understandable considering the provisional positioning of the new conference platform in the year of the foundation 1996.

Table 1 illustrates the attempt of finding a connection between the *topics of interest* and the *session labels* appearing in the conference proceedings. Another compressing was performed to this end (original number: 50 labels). Matching labels, however, could not be spotted for 11 topics listed in the *call for papers* and furthermore, the problem of *similarity* and *closest match* turned up.

TABLE 1. Overview on the topics of CAADRIA with corresponding session labels.

Call for Papers: Topics (1996-2001)	**Sessions labels (1996-2001)**
Building System Engineering and Analysis [3]	Application and Analysis of Architecture
CAAD Teaching and Research Directions in Asia [2]	Research Directions (Data and Knowledge) / Perspectives in Teaching [3]
Case-based Reasoning [4]	
Cognitive Studies in Design [3]	Cognitive Design Methods
Computer-based Design Methodologies	
Computers & Design Pedagogy / Digital design education [2]	(Design) Education / Curricula and Teaching Applications [3]
Construction Robotics [3]	
Cooperative/Collaborative Design [4]	Cooperative/Collaborative Design [5]
Decision Support Systems [3]	
Design Creativity / Design Evaluation [5]	
Design Kinematics and Animation [3]	
Digital/Electronic Design Media [6]	Digital Media and Design Education / Design Tools [3]
Environmental Simulation [4]	Simulation [2]
Generative Systems [5]	Generative Design/Systems [2]
Geographic Information Systems [4]	Regional Information and Information Delivery System
Human Computer Interaction [5]	Human Computer Interface / Interaction and Industrial Design [2]
Information Delivery Systems for Design [3]	Information (Delivery) Systems / Modeling / Structure and Management [4]
Integrated Building Models	
Knowledge-based Design Tools - AI [3]	Knowledge Representation
Models of Design [3]	Design Modeling / Process / Concepts / Creativity [5]
Precedence and Prototypes [4]	Precedence and Prototypes [3]
Prediction and Evaluation [4]	Prediction and Evaluation [3]
Rapid Prototyping [3]	
Scene and Product Modeling [3]	
Shape Grammar - Shape Recognition and Emergence [7]	Shape Studies and Grammars resp. Generative Systems [3]
Space Planning & FM [3]	
Trends in Practice [4]	
Virtual Reality / Virtual Architecture [6]	Virtual Reality and Automation / Digital Scene / Computer Media – VE's [5]
Web-based (Collaborative) Design [2]	Teaching Tools [1]

Therefore, the findings presented below are to be regarded as an approximation. Subsequently, the 19 session labels were linked with 268 of the total of 285 papers (17 papers not assigned to any session) in order to determine frequency distribution.

TABLE 2. Ranking of session labels and corresponding CAADRIA-papers (1996-2001).

Sessions labels	**Papers**
Virtual Reality (...) / VE's	34
Cooperative/Collaborative Design	31
Shape Studies and Grammars resp. Generative Systems	30
(Design) Education / Curricula and Teaching Applications	20
Design Modeling/Process/Concepts/Creativity	20
Information (Delivery) Systems (...) and Management	19
Research Directions (...) / Perspectives in Teaching	17
Prediction and Evaluation	17
Digital Media and Design Education / Design Tools	15
Precedence and Prototypes	14
Simulation	9
Regional Information and Information Delivery System	9
Generative Design/Systems	7
Knowledge Representation	7
Human Computer Interface / Interaction and Industrial Design	6
Application and Analysis of Architecture	5
Teaching Tools	5
Cognitive Design Methods	3

As a rule conference papers contain references specifying their positioning within the particular context of topics. With a few exceptions this applied to most CAADRIA-papers and any research work to this end cover the period of 1998-2001 (1996 and 1997 are missing, because the pdf-files are just scans without ocr). Approx. 200 papers indicated a total of more than 2.000 references, which means that the average number of citations per paper is 10. These references were taken from pdf-files and broken down into four components: author(s), year, title and source. Even though this splitting up was performed by means of program routine manual re-editing was necessary as the uniform quotation manner is not available in all cases. Table 3 shows a "TOP 23", based on a minimum of 10 references (as first authors). Therefore, e.g. a publication of "Schön und Wiggins" quoted thirteen times is not listed separately, but subsumed to "Schön".

TABLE 3. Ranking of authors in CAADRIA-references (1996-2001).

Rank	Author	Number of references
1	Mitchell, William J.	43
2	Schön, Donald A.	37
3	Liu, Y.T.	36
4	Stiny, George	34
5	Gero, John S.	32
6	Chiu, Mao-Lin	27
7	Suwa, M.	27
8	Goldschmidt, G.	25
9	Akin, Ö.	24
10	Maher, Mary Lou	22
11	Koutamanis, A.	18
12	Sasada, Tsuyoshi	18
13	Woodbury, R.F.	17
14	Simon, H.A.	16
15	Cross, N.	13
16	Coyne, Richard	12
17	Kaga, A.	12
18	Kurmann, David	12
19	Morozumi, Mitsuo	11
20	Oxman, Rivka E.	11
21	Eastman, C.M.	10
22	Frazer, John	10
23	Wojtowicz, J.	10

Practically a quarter of the total number of references is included in this "TOP 23". The following table contains the most frequently quoted references and it surely comes as no surprise that all of the authors listed below also appear in Table 3.

Publications in books are not as common and the Magazine *Design Studies* ranks as the most frequently enumerated source of publication. Naturally the rankings presented in this contribution may be regarded as mere academic playfulness. Despite the fact that the field of conceivable combinations has not been fully covered an attempt is made not only to gather experience acquired resulting from conference activities in form of publications, but also to make specifications as to their substance matter and here a certain concentration on the most quoted publications can be noticed. Even though such a scope of knowledge may be particularly useful regarding newcomers, a snowball effect is to be avoided by all means.

TABLE 4. Ranking of references in CAADRIA-references (1996-2001).

Reference	
Schön, D.A. and Wiggins, G.: 1992, Kinds of Seeing and Their Functions in Designing, in *Design Studies*, 13(2), pp. 135-156.	14
Schön, Donald A.: 1983, *The Reflective Practitioner: How Professionals Think in Action*, Basic Books, New York.	13
Mitchell, William J.: 1995, City of Bits - Space, Place and Infobahn, MIT Press.	9
Suwa, M., Purcell, T. and Gero, J.S.: 1997, Macroscopic Analysis of Design Processes Based on a Scheme for Coding Designers' Cognitive Actions, in *Design Studies*, 19(4), pp. 455-483.	8
Mitchell, William J.: 1990, *The Logic of Architecture: Design, Computation and Cognition*, MIT Press, London.	8
Sasada, Tsuyoshi : 1995, Computer Graphics as a Communication Medium in the Design Process, in *The Global Design Studio* [Proceedings CAADFutures 95, Singapore], pp. 3-5.	7
Goldschmidt, G.: 1994, On Visual Design Thinking: The Vis Kids of Architecture, in *Design Studies*, 15(2), pp. 158-174.	7
Goldschmidt, G.: 1991, The Dialectics of Sketching, in *Creativity Research Journal*, 4(2), pp.123-143.	7
Stiny, G. and Mitchell, W.J. : 1978, The Palladian Grammar, in Environment and Planning B (5), pp. 5-18.	7
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Suwa M. and Tversky B.: 1997, What Do Architects and Students Perceive in Their Design Sketches? A Protocol Analysis, in *Design Studies* 18 (4), pp. 385-403.	7
Mitchell, William J.: 1995, *City of Bits*, MIT Press, Cambridge (MA).	7
Mitchell, W.J. and McCullough, M.: 1991, *Digital Design Media*, VNR, New York.	6
Liu, Y.T.: 1996, Restructuring shapes in Terms of Emergent Subshapes: A Computational and Cognitive Model, in *Environment and Planning B*, (23), pp. 313-328.	6
Liu, Y.T.: 1995, Some Phenomena of Seeing Shapes in Design, in Design Studies, 16(3), pp. 367-385.	6
Simon, H.A.: 1992, *The Science of the Artificial*, MIT Press, Cambridge (MA).	6
Stiny, George: 1980, Introduction to Shape and Shape Grammars, in Environment and Planning B (7), pp. 343-351.	5
Akin, Ö.: 1986, Psychology of Architectural Design, Pion, London.	5
Chiu, M.L.: 1997, Representations and Communication Channels in Collaborative Architectural Design, in *Proceedings Third International IFIP WG5.2*, pp.77-96.	5

4. Conclusion and Outlook

Within this six-year period the published number of CAADRIA papers has become too large to issue a complete overview without relying on a computer-assisted database and to be able to recall the scope of findings resulting from all and every publication in detail. After all, we are dealing with nearly 3.000 published pages continuously increasing every year by a

further 500 pages, probably not to be handled mentally and leading to a situation of literally being "overnewsed but underinformed" Therefore, assistance regarding efficient information mastering will be gaining in significance for the years ahead. This also entails the possibility of availability to be accomplished at low cost by means of electronic papers.

The references quoted in the papers also represent a relevant item in terms of statistics. The overview presented here is to be regarded as a first approximation as interlinking of references with each other as well as cross-linking with the CUMINCAD-records might lead to a novel way of consideration. Thus future interest may also be directed to the connection of the most quoted references and their correlating papers. In the end both the selections of the references as well as the sessions etc. are a result of human structuring ability and could be useful for machine learning efforts. While the information in which session a paper was presented, is not a typical bibliographical entry it could prove very valuable in our attempt to automatically classify or cluster the papers because this provides a training set for the classification algorithm. What is to be taken for granted is that similar paper will quote similar references, i.e. references are made to those publications connected with the individual topic. Thus determining supposed similarity of conference papers could also be performed by comparing the references given. A certain degree of fuzziness must be accepted as references occasionally are considered as mere decorative items.

Further research and even more so demonstration work will be required to point out all resulting benefits and to re-engineer parts of the scientific publication process by establishing a fully functioning on-line service, where scientific output would be available almost for free and where a virtual on-line community of authors and readers would meet. Among a set of technological tasks a corresponding research agenda will be handled in the framework of a research project called "SciX - Open, Self Organizing Repository for Scientific Information Exchange" which is funded by the EU [2002-2003, http://www.scix.net/].

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