

Lecture Notes in Computer Science

Edited by G. Goos, J. Hartmanis and J. van Leeuwen

1507

Springer

Berlin

Heidelberg

New York

Barcelona

Hong Kong

London

Milan

Paris

Singapore

Tokyo

Tok Wang Ling Sudha Ram
Mong Li Lee (Eds.)

Conceptual Modeling - ER '98

17th International Conference
on Conceptual Modeling
Singapore, November 16-19, 1998
Proceedings



Springer

Series Editors

Gerhard Goos, Karlsruhe University, Germany
Juris Hartmanis, Cornell University, NY, USA
Jan van Leeuwen, Utrecht University, The Netherlands

Volume Editors

Tok Wang Ling
Mong Li Lee
National University of Singapore
School of Computing, Department of Computer Science
55 Science Drive 2, Singapore 117599
E-mail: {lingtw,leeml}@comp.nus.edu.sg

Sudha Ram
University of Arizona, Department of Management Information Systems
430J McClelland Hall, College of BPA
Tuscon, AZ 85721, USA
E-mail: ram@bpa.arizona.edu

Cataloging-in-Publication data applied for

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Conceptual modeling : proceedings / ER '98, 17th International Conference on Conceptual Modeling, Singapore, November 16 - 19, 1998. Tok Wang Ling ; Sudha Li Lee (ed.). - Berlin ; Heidelberg ; New York ; Barcelona ; Budapest ; Hong Kong ; London ; Milan ; Paris ; Singapore ; Tokyo : Springer, 1998
(Lecture notes in computer science ; Vol. 1507)
ISBN 3-540-65189-6

CR Subject Classification (1991): H.2, H.4, F.1.3, F.4.1, I.2.4, H.1, J.1

ISSN 0302-9743

ISBN 3-540-65189-6 Springer-Verlag Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, especially the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1998
Printed in Germany

Typesetting: Camera-ready by author
SPIN 10639013 06/3142 - 5 4 3 2 1 0 Printed on acid-free paper

Foreword

I would like to welcome you to Singapore and the 17th International Conference on Conceptual Modeling (ER'98). This conference provides an international forum for technical discussion on conceptual modeling of information systems among researchers, developers and users. This is the first time that this conference is held in Asia, and Singapore is a very exciting place to host ER'98. We hope that you will find the technical program and workshops useful and stimulating.

The technical program of the conference was selected by the distinguished program committee consisting of two co-chairs and 83 members. Credit for the excellent final program is due to Tok Wang Ling and Sudha Ram. Special thanks to Frederick H. Lochovsky for selecting interesting panels, and Alain Pirotte for preparation of attractive tutorials. I would also like to thank Yong Meng Teo (Publicity Chair), and the region co-ordinators, Alberto Laender, Erich Neuhold, Shiwei Tang, and Masaaki Tsubaki, for taking care of publicity.

The following three workshops are also organized to discuss specific topics of data modeling and databases: "International Workshop on Data Warehousing and Data Mining" organized by Sham Navathe (Workshop chair) and Mukesh Mohania (Program Committee Chair), "International Workshop on New Database Technologies for Collaborative Work Support and Spatio-Temporal Data Management" organized by Yoshifumi Masunaga, and "International Workshop on Mobile Data Access" organized by Dik L. Lee. Ee Peng Lim took care of all detailed work related to the workshops. I would like to thank all these people who organized the workshops as well as the members of program committees. The workshop proceedings will be published jointly after the workshop.

I would also like to express my appreciation to other organizing committee members, Chuan Heng Ang (Publication), Hock Chuan Chan (Registration), Mong Li Lee and Danny Poo (Local Arrangements), Cheng Hian Goh (Treasurer), and Kian Lee Tan (Industrial Chair). Special thanks to Tok Wang Ling who worked as the central member of the organizing committee, and who made my job very easy. Last, but not least, I would like to express thanks to the members of the Steering Committee, especially to Stefano Spaccapietra (Chair), Bernhard Thalheim (Vice Chair), and Peter Chen (Chair, Emeritus) who invented the widely used ER model and started this influential conference.

Finally I would like to thank all the sponsors and attendees of the conference, and hope that you will enjoy the conference, the workshops, and Singapore to the utmost extent.

Program Chairs' Message

The 17th International Conference on Conceptual Modeling (ER'98) is aimed at providing an international forum for technical discussion among researchers, developers, practitioners, and users whose major emphasis is on conceptual modeling. This conference was originally devoted to the Entity-Relationship (ER) model, but has long since expanded to include all types of semantic data modeling, behavior and process modeling, and object-oriented systems modeling. This year's conference embraces all phases of software development including analysis, specification, design, implementation, evolution, and reengineering. Our emphasis this year has been to bring together industry and academia to provide a unique blend of original research and contributions related to practical system design using conceptual modeling. We have an exciting agenda focusing on emerging topics ranging from conceptual modeling for Web based information systems to data warehousing and industrial case studies on the use of conceptual models.

The conference attracted 95 papers from authors in 31 different countries. Both industry and academic contributions were solicited. Similarly high standards were applied to evaluating both types of submissions. Of the submissions, 32 were accepted for presentation at the conference based on extensive reviews from the Program Committee and external reviewers. The program consists of 26 research papers and 6 industrial papers representing 17 different countries from around the globe. The entire submission and reviewing process was handled electronically, which proved to be a challenge and a blessing at the same time.

A conference of this magnitude is the work of many people. The program committee with the help of external reviewers worked under a tight schedule to provide careful, written evaluations of each paper. Mong Li Lee, Chuan Heng Ang, Choon Leong Chua, and Sew Kiok Toh helped to coordinate the review of our electronic submission and review system, tabulated the scores and distributed reviews to authors. Since the program co-chairs are from two different continents, great coordination was required and achieved through the use of the Internet. Jinsoo Park from the University of Arizona and Mong Li Lee from the National University of Singapore did an outstanding job of assisting the Program Co-Chairs.

On behalf of the entire ER'98 committee, we would like to express our appreciation to all the people who helped with the conference. Finally, our thanks to all of you for attending the conference here in Singapore.

We wish you a week of fun in the enchanting garden city of Singapore!

Conference Organization

Conference Chair:

Yahiko Kambayashi (Kyoto University, Japan)

Program Co-Chairs:

Tok Wang Ling (National University of Singapore, Singapore)

Sudha Ram (University of Arizona, USA)

Panel Chair:

Frederick H. Lochovsky (HK University of Science & Technology, Hong Kong)

Tutorial Chair:

Alain Pirotte (University of Louvain, Belgium)

Publication Chair:

Chuan Heng Ang (National University of Singapore, Singapore)

Registration Chair:

Hock Chuan Chan (National University of Singapore, Singapore)

Finance Chair:

Cheng Hian Goh (National University of Singapore, Singapore)

Local Arrangements Co-Chairs:

Mong Li Lee (National University of Singapore, Singapore)

Danny Poo (National University of Singapore, Singapore)

Workshop Chair:

Ee Peng Lim (Nanyang Technological University, Singapore)

Industrial Chair:

Kian Lee Tan (National University of Singapore, Singapore)

Publicity Chair:

Yong Meng Teo (National University of Singapore, Singapore)

Steering Committee Representatives:

Stefano Spaccapietra (Swiss Federal Institute of Technology, Switzerland)

Bernhard Thalheim (Cottbus Technical University, Germany)

Peter Chen (Louisiana State University, USA)

Region Co-ordinators:

Alberto Laender (Federal University of Minas Gerais, Brazil)

Erich Neuhold (German National Research Center for Information Technology, Germany)

Masaaki Tsubaki (Data Research Institute, Japan)

Shiwei Tang (Peking University, China)

Tutorials

Multimedia Information Retrieval, Categorisation and Filtering by Carlo Meghini and Fabrizio Sebastini (CNR Pisa, Italy)

Co-design of Structures, Processes and Interfaces for Large-Scale Reactive Information Systems by Bettina Schewe, Klaus-Dieter Schewe and Bernhard Thalheim (Germany)

Advanced OO Modeling: Metamodels and Notations for the Next Millennium by Brian Henderson-Sellers, Rob Allen, Danni Fowler, Don Firesmith, Dilip Patel, and Richard Due

Modeling Information Security - Scope, State-of-the-Art, and Evaluation of Techniques by Gunther Pernul and Essen (Germany)

Spatio-Temporal Information Systems: a Conceptual Perspective by Christine Parent, Stefano Spaccapietra, and Esteban Zimanyi (EPFL Lausanne, Switzerland)

Workshops

Data Warehousing and Data Mining

Chair: Sham Navathe (Georgia Institute of Technology, USA)

Program Chair: Mukesh Mohania (University of South Australia, Australia)

Mobile Data Access

Chair: Dik L. Lee (HK University of Science and Technology, Hong Kong)

New Database Technologies for Collaborative Work Support and Spatio-Temporal Data management

Chair: Yoshifumi Masunaga (University of Library and Info. Science, Japan)

Program Committee

Peter Apers, The Netherlands
Akhilesh Bajaj, USA
Philip Bernstein, USA
Elisa Bertino, Italy
Glenn Browne, USA
Stefano Ceri, Italy
Hock Chuan Chan, Singapore
Chin-Chen Chang, Taiwan
Arbee L. P. Chen, Taiwan
Roger Hsiang-Li Chiang, Singapore
Joobin Choobineh, USA
Phillip Ein-Dor, Israel
Ramez Elmasri, USA
David W. Embley, USA
Tetsuya Furukawa, Japan
Georges Gardarin, France
Cheng Hian Goh, Singapore
Wil Gorr, USA
Terry Halpin, USA
Igor Hawryszkiewicz, Australia
Alan Hevner, USA
Uwe Hohenstein, Germany
Sushil Jajodia, USA
Ning Jing, China
Leonid Kalinichenko, Russia
Hannu Kangassalo, Finland
Jessie Kennedy, UK
Hiroyuki Kitagawa, Japan
Ramayya Krishnan, USA
Gary Koehler, USA
Prabhudev Konana, USA
Uday Kulkarni, USA
Akhil Kumar, USA
Takeo Kunishima, Japan
Alberto Laender, Brazil
Laks V. S. Lakshmanan, Canada
Per-Ake Larson, USA
Dik-Lun Lee, China
Mong Li Lee, Singapore
Suh-Yin Lee, Taiwan
Qing Li, China
Stephen W. Liddle, USA
Ling Liu, USA
Pericles Loucopoulos, UK
Leszek A. Maciaszek, Australia
Stuart E. Madnick, USA
Kia Makki, USA
Salvatore March, USA
Heinrich C Mayr, Austria
Vojislav Misisic, China
David E. Monarchi, USA
Shamkant Navathe, USA
Erich Neuhold, Germany
Peter Ng, USA
Dan O'Leary, USA
Maria E Orłowska, Australia
Aris Ouksel, USA
Mike Papazoglou, The Netherlands
Jeff Parsons, Canada
Joan Peckham, USA
Niki Pissinou, USA
Calton Pu, USA
Sandeep Purao, USA
Sury Ravindran, USA
Arnon Rosenthal, USA
N L Sarda, India
Sumit Sarkar, USA
Arun Sen, USA
Peretz Shoval, Israel
Keng Leng Siau, USA
Il-Yeol Song, USA
Stefano Spaccapietra, Switzerland
Veda Storey, USA
Toby Teorey, USA
Bernhard Thalheim, Germany
A Min Tjoa, AUSTRIA
Alex Tuzhilin, USA
Ramesh Venkataraman, USA
Yair Wand, Canada
Kyu-Young Whang, Korea
Carson Woo, Canada
Jian Yang, Australia
Masatoshi Yoshikawa, Japan

External Referees

Iqbal Ahmed
Hiroshi Asakura
H. Balsters
Linda Bird
Jan W. Buzydlowski
Sheng Chen
Yam San Chee
Sheng Chen
Wan-Sup Cho
Eng Huang Cecil Chua
Peter Fankhauser
Thomas Feyer
George Giannopoulos
Spot Hua
Gerald Huck
Hasan M. Jamil
Panagiotis Kardasis
Justus Klingemann
Suk-Kyoon Lee
Wegin Lee

Ki-Joune Li
Jun Li
Hui Li
Weifa Liang
Ee Peng Lim
P. Louridas
Sam Makki
Elisabeth Métais
Wilfred Ng
E. K. Park
Ivan Radev
Rodolfo Resende
Klaus-Dieter Schewe
Takeyuki Shimura
Kian-Lee Tan
Thomas Tesch
Chiou-Yann Tsai
Christelle Vangenot
R Wilson

Organized By

School of Computing, National University of Singapore

Sponsored By

ACM

The ER Institute

In Cooperation with

School of Applied Science, Nanyang Technological University

Singapore Computer Society

Information Processing Society of Japan

Corporate Sponsors

Beacon Information Technology Inc., Japan

CSA Automated Pte Ltd

Digital Equipment Asia Pacific Pte Ltd

Fujitsu Computers (Singapore) Pte Ltd

IBM Data Management Competency Center (Singapore)

Lee Foundation

NSTB(National Science and Technology Board)

Oracle Systems S.E.A. (S) Pte Ltd

Sybase

Taknet Systems Pte Ltd



Table of Contents

Keynote 1:

The Rise, Fall and Return of Software Industry in Japan	1
<i>Yoshiaki Ishii (Beacon Information Technology Inc., Japan)</i>	

Session 1: Conceptual Modeling and Design

Conceptual Design and Development of Information Services	7
<i>Thomas Feyer, Klaus-Dieter Schewe, Bernhard Thalheim, Germany</i>	

An EER-Based Conceptual Model and Query Language for Time-Series Data	21
<i>Jae Young Lee, Ramez A. Elmasri, USA</i>	

Chrono: A Conceptual Design Framework for Temporal Entities	35
<i>Sonia Bergamaschi, Claudio Sartori, Italy</i>	

Session 2: User Interface Modeling

Designing Well-Structured Websites: Lessons to Be Learned from Database Schema Methodology	51
<i>Olga De Troyer, The Netherlands</i>	

Formalizing the Informational Content of Database User Interfaces	65
<i>Simon R. Rollinson, Stuart A. Roberts, UK</i>	

Session 3: Information Retrieval on the Web

A Conceptual-Modeling Approach to Extracting Data from the Web	78
<i>D.W. Embley, D.M. Campbell, Y.S. Jiang, S.W. Liddle, Y.-K. Ng, D.W. Quass, R.D. Smith, USA</i>	

Information Coupling in Web Databases	92
<i>Sourav S. Bhowmick, Wee-Keong Ng, Ee-Peng Lim, Singapore</i>	

Structure-Based Queries over the World Wide Web	107
<i>Tao Guan, Miao Liu, Lawrence V. Saxton, Canada</i>	

Session 4: Semantics and Constraints

Integrated Approach for Modelling of Semantic and Pragmatic Dependencies
of Information Systems 121
Remigijus Gustas, Sweden

Inference of Aggregate Relationships through Database Reverse
Engineering 135
Christian Soutou, France

On the Consistency of Int-cardinality Constraints 150
Sven Hartmann, Germany

Panel 1:

Realizing Next Generation Internet Applications: Are There Genuine Research
Problems, or Is It Advanced Product Development? 164
Chairpersons: Kamalakara Karlapalem and Qing Li, Hong Kong

Keynote 2:

Web Sites Need Models and Schemes 165
Paolo Atzeni, Università di Roma Tre, Italy

Session 5: Conceptual Modeling Tools

ARTEMIS: A Process Modeling and Analysis Tool Environment 168
S. Castano, V. De Antonellis, M. Melchiori, Italy

From Object Oriented Conceptual Modeling to Automated Programming
in Java* 183
Oscar Pastor, Vicente Pelechano, Emilio Insfrán, Jaime Gómez, Spain

An Evaluation of Two Approaches to Exploiting Real-World Knowledge by
Intelligent Database Design Tools 197
Shahrul Azman Noah, Michael Lloyd-Williams, UK

Session 6: Quality and Reliability Metrics

Metrics for Evaluating the Quality of Entity Relationship Models 211
Daniel L. Moody, Australia

A Transformational Approach to Correct Schema Renamings	226
<i>Donatella Castelli, Serena Pisani, Italy</i>	

The Guidelines of Modeling - An Approach to Enhance the Quality in Information Models	240
<i>Reinhard Schuette, Thomas Rotthowe, Germany</i>	

Industrial Session 1: Industrial Experiences in Conceptual Modeling

Improving the Quality of Entity Relationship Models - Experience in Research and Practice	255
<i>Daniel Moody, Graeme G. Shanks, Peta Darke, Australia</i>	

The TROLL Approach to Conceptual Modelling: Syntax, Semantics and Tools	277
<i>Antonio Grau, Juliana Küster Filipe, Mojgan Kowsari, Silke Eckstein, Ralf Pinger, Hans-Dieter Ehrlich, Germany</i>	

Process Failure in a Rapidly Changing High-Tech Organisation: A System Dynamics View	291
<i>Bruce Campbell, Australia</i>	

Session 7: Object-Oriented Database Management Systems

ROL2: A Real Deductive Object-Oriented Database Language	302
<i>Mengchi Liu, Min Guo, Canada</i>	

Multiobjects to Ease Schema Evolution in an OODBMS	316
<i>Lina Al-Jadir, Michel Léonard, Switzerland</i>	

Implementation of Automatic Lock Determination in C++-based OODBMSs	334
<i>Yong S. Jun, Eunji Hong, Suk I. Yoo, Korea</i>	

Panel 2:

Do We Need Information Modeling for the Information Highway?	348
<i>Panel chair: Bernhard Thalheim, Germany</i>	

Session 8: Data Warehousing

Design and Analysis of Quality Information for Data Warehouses*	349
<i>Manfred A. Jeusfeld, The Netherlands, Christoph Quix, Matthias Jarke, Germany</i>	
Data Warehouse Schema and Instance Design	363
<i>Dimitri Theodoratos, Timos Sellis, Greece</i>	
Reducing Algorithms for Materialized View Updates	377
<i>Tetsuya Furukawa, Fei Sha, Japan</i>	

Industrial Session 2: Industrial Case Studies

Reengineering Conventional Data and Process Models with Business Object Models: A Case Study Based on SAP R/3 and UML	393
<i>Eckhart v. Hahn, Barbara Paech, Germany, Conrad Bock, USA</i>	
An Active Conceptual Model for Fixed Income Securities Analysis for Multiple Financial Institutions	407
<i>Allen Moulton, Stéphane Bressan, Stuart E. Madnick, Michael D. Siegel, USA</i>	
An Entomological Collections Database Model for INPA	421
<i>J. Sonderegger, P. Petry, J.L. Campos dos Santos, N.F. Alves, Brazil</i>	

Session 9: Object-Oriented Approaches

A Global Object Model for Accommodating Instance Heterogeneities	435
<i>Ee-Peng Lim, Roger H.L. Chiang, Singapore</i>	
On Formalizing the UML Object Constraint Language OCL	449
<i>Mark Richters, Martin Gogolla, Germany</i>	
Derived Horizontal Class Partitioning in OODBs: Design Strategies, Analytical Model and Evaluation	465
<i>Ladjel Bellatreche, Kamalakar Karlapalem, Qing Li, Hong Kong</i>	
Author Index	481