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The AMCIS 2003 Panels of IS Education-II: The Chicken and the Egg Debate: Positioning Database Content in the Information Systems Curriculum

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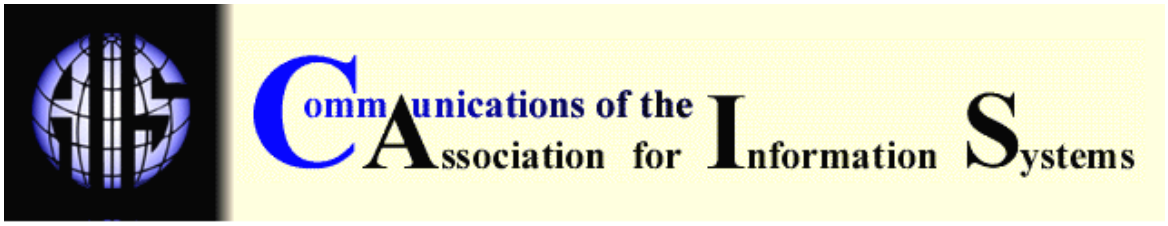

THE AMCIS 2003PANELS ON IS EDUCATION-II THE CHICKEN AND THE EGG DEBATE: POSITIONING DATABASE CONTENT IN THE INFORMATION SYSTEMS CURRICULUM

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ABSTRACT

This paper summarizes the results of a panel on how database content is covered in current university programs, with reference to the IS2002 model curriculum. Panelists included information systems (IS) faculty members who are actively involved in determining the coverage of database content at their institutions and in establishing academy-wide database content and technology resources. Topics included positioning database content in the overall curriculum, sequencing of content within the database course(s), and summary suggestions for tailoring database coverage at colleges and universities.

Keywords: IS2002, model curriculum, database education

FOREWORD

Each year, since August 2001, the education tracks at AMCIS have included panels on education. This article is one of two based on the 2003 AMCIS panels to be reported in CAIS. The panels provide a forum where academics discuss the varied ways in which they teach the IS curriculum. They are intended to inform the community of the continually changing tools and techniques used in the classroom and in practice. They provide a way for faculty to keep pace with technological change.

The two panels published this year (this paper and CAIS Volume 14, Article 6 [Salisbury et al. 2004]) are the result of a careful winnowing process. Ten panel proposals were submitted for 2003, and five of them were presented at AMCIS. Articles about several of the panels were submitted for inclusion in CAIS. Of these, two were selected after review.

Kevin Lee Elder, Education Track Chair

I. INTRODUCTION

This paper summarizes the panel discussion at AMCIS 2003 about how database content is taught in current university programs. The IS2002 model curriculum [Gorgone, et al., 2003] served as the reference. The panelists were information systems (IS) faculty members who are actively involved in determining the coverage of database content at their institutions and in establishing academy-wide database content and technology resources (e.g., textbooks, Birds-of-a-Feather conference discussions/roundtables, Teradata University Network, and ISWorld Database Educators Web Resources). The paper summarizes the key points from the panel discussion and, in Section IV and Appendix I, presents a bibliography of resources for database educators.

Two major topics highlighted a “what comes first: the chicken or the egg?” debate:

> 1. At a macro, curriculum-level: where/how should database content be covered in an information systems curriculum (Section II).
>
> 2. At a micro, course-level: how should SQL and data modeling content within a database course be sequenced (Section III).

The panelists were:

Chelley Vician, Michigan Technological University, chair,
Monica Garfield, Bentley College
Jeffrey Hoffer, University of Dayton
Mary Prescott, University of Tampa
Bruce Rollier, University of Baltimore
Diane M. Strong, Worcester Polytechnic Institute
Kevin Lee Elder, Air Force Institute of Technology, Track Chair

II. MACRO LEVEL: WHERE SHOULD DATABASE BE COVERED IN THE CURRICULUM?

In the IS2002 model curriculum (Gorgone, et al., 2003), database content coverage is most often associated with the IS2002.8 Physical Design and Implementation with DBMS course specification. The IS2002.8 course emphasizes the physical design and implementation of a database, and relies upon prior completion of the IS2002.7 Analysis and Logical Design course. As highlighted by the panelists’ presentations and discussion with the audience, the conceptual and logical design of databases is somewhat difficult for most students (especially undergraduates) to grasp when not linked with the practical experience of physical implementation.

DATABASE AND IS PROFESSIONALS

For most panelists, database content in their institution is packaged into a single course in the requirements for information systems majors. The typical database course emphasizes the conceptual and logical design of databases (emphasizing the relational model), covers SQL, and often requires completion of a term-long database design project to provide practical experience with design knowledge. In about half the schools represented on the panel, the database course preceded the systems analysis and design course; in the other half it succeeded systems analysis and design. Key reasons for differences in sequencing included:

1. The maturity of students: if sequenced early, students tend to have poor study habits; if sequenced later, it is too late for students to change their major if they find out the information systems area is not a good "fit" for their career choice; and

2. The belief that student understanding of data structuring is easier than understanding processes, which is often the emphasis in an analysis and design course.

One panelist described how database content is largely covered in a single course, but that treatment of database content in the institution's curriculum is pervasive and repetitive. The importance of data and data management is emphasized throughout the curriculum in multiple courses.

Three key insights emerged :

1. The skills and knowledge necessary to be a successful IS professional rely on the foundational knowledge generally presented in both Database and Systems Analysis and Design courses.

The issue that IS educators need to address is not "Should Database precede (or follow) Systems Analysis and Design in the curriculum", but rather "What is the best way to prepare future IS professionals so that they can encapsulate business rules in information systems?" An underlying assumption of this educational issue is that the conceptual and logical modeling knowledge and skills from typical Database and Systems Analysis and Design courses serve as the building blocks and cornerstones of an IS professional's preparation. The panel believes that IS educators should attend to the primacy of this underlying assumption when developing courses and curriculum.

2. Related to the first insight, when developing an IS curriculum, faculty need to remember that a curriculum is not just a set of courses that happen to relate to one another solely by having content related to information technologies.

Rather, a curriculum should consist of courses that link together and serve to support the larger goal of an IS professional's preparation for industry careers. Thus, what we generally consider traditional database content (e.g., modeling, normalization, SQL) is perhaps best presented in a single course. However, it should be presented in a curriculum as a meaningful sequence of learning experiences that emphasize how data in business organizations are essential building blocks to providing answers to business questions and driving business operations. A curriculum provides integrated learning experiences for students within the goals of a particular school's IS program goals. A curriculum should be built using a spiraling concept to introduce/preview IS content to produce learner awareness in early learning experiences. The learner should advance to a literacy or comprehension stage through use in the middle learning experiences. In the later learning experiences the student should reach advanced stages where they can develop and extend their understanding of the IS content without hints or prompts. For example, the initial concept of databases can be previewed in an early introductory programming class that will use the programming language to obtain data from a database. The initial experience of using a database can then be brought forward when students complete a small database design project in a required IS class for all business

students. In an advanced class they can choose their own database software to support and implement their term project. A multi-course learning experience that provides longitudinal experience with the analysis, design, and implementation of databases should be a goal or objective of any IS Curriculum.

3. Database content is also provided to non-IS majors. Panelists and audience members agreed with the rising importance of (organizational) databases in current and future business environments. IS majors need further specialization in database matters than most functional specialists in Finance, Marketing, and Operations. Some institutions do not have the luxury of separate courses or sections of the Database course for non-IS majors. At issue for IS database educators is the age-old challenge of providing enough depth for the IS major's professional preparation yet not so much depth that the non-IS major cannot glean useful knowledge for his/her future business career. Panelists and audience members agreed that the ideal solution is to have separate courses or at least sections to address the diverging educational needs of the IS and non-IS majors. When the separate course/section alternative is not viable at an institution, then the introductory database course for all students could be structured to accommodate both types of students by varying individual assignments, creatively developing project teams with different roles for students from different majors, or by providing additional, deeper assignments for the IS major. Another alternative under this scenario is to cover the introductory database concepts in the initial IS course, and then to require a follow on course in database for IS majors that covers material more deeply and extends database knowledge into matters such as database administration, data quality, security, and other advanced topics.

DATABASE CONTENT AND OTHER IS COURSES

The panel then focused on the relationship of the database course to other courses in the IS curriculum. Panelists and audience members agreed that the ideal situation is 6 to 9 credit hours of courses that are tightly coupled, such that an integrated, longitudinal, learning experience focusing on the analysis, design, and implementation of systems can be provided for an IS professional's preparation.

Although tightly coupled courses for IS majors are desirable, they cannot always be achieved because of idiosyncrasies of the student population. For example, one of the issues with tightly coupled courses is how to design the content and instructional approaches so that students who are not able to follow the sequence due to university absences (such as co-ops, internships, or withdrawals) or course scheduling conflicts are not disadvantaged in their professional preparation.

Another concern raised by the audience is the relationship of the database course with an object-oriented analysis and design (OOAD) course. Audience members observed that some OOAD courses stress the encapsulation of data as part of the object with often little discussion of how the data are logically related (e.g., without coverage of class diagramming). As a result, when students then are exposed to a relational database they can find themselves lost in the topics of normalization, relations, and foreign keys. The panel responded by reiterating the importance of a coordinated curriculum. For example, is OOAD an advanced course addressing an alternative analysis and design approach that is taken by advanced students or is it the standard approach to the system analysis and design course? If it is the standard approach, then there may be inconsistencies and insufficient cross-linking of the systems analysis and design course using the OOAD approach with a traditional relational database course that does not mention object-oriented modeling. These issues need to be resolved by the IS faculty at a particular institution.

III. MICRO LEVEL: DATABASE CONTENT SEQUENCING

Each major database textbook chooses a particular order for the presentation of information related to data modeling and SQL. Database educators often choose textbooks that mirror their preferences for presenting these topics. Some prefer to teach modeling prior to SQL, others prefer to teach SQL first, and some attempt to integrate the presentation of these topics. This sequencing argument is akin to a "chicken and egg" debate.

MODELING, THEN SQL

Providing a progression of modeling topics followed by SQL re-emphasizes the separation of logical and physical elements of databases. Theoretical data modeling, especially conceptual modeling, is independent of the physical and specific database management technology choices for implementation. If following an information systems architecture approach [Zachman, 1987], enterprise and conceptual data modeling must precede logical and physical database design. An advantage of the "modeling first approach" is that the foundational data modeling knowledge can be leveraged for different DBMS outcomes (e.g., hierarchical, network). SQL, as a very specific tool for relational databases, is best positioned after a thorough coverage of conceptual data modeling, logical design for the relational model, and normalization. A downside of this approach is that modeling knowledge and skills are often perceived as abstract and difficult for students (especially undergraduates) to understand in the absence of practical database examples.

One way to implement the 'Modeling, then SQL' approach is to consider the whole MIS curriculum. If systems analysis content is a prerequisite to the database course, and if the systems analysis content emphasizes data modeling (along with other models of information systems), then this preferred sequence is maintained.

SQL, THEN MODELING

SQL is a relatively simple tool for accessing the content of relational databases and providing simple reports as answers to questions. SQL provides tangible interaction with a physical database at the tables level, a concept that many students are familiar with from spreadsheets in accounting or from mathematics classes. When SQL coverage precedes modeling coverage, students are able to link their physical experience of using a database to accomplish managerial tasks (e.g., finding the answer to a question or set of questions from organizational data) with the abstract nature of data modeling.

Using this approach, the professor typically starts with the relational model, covering entities and attributes at a general level, and quickly moves to tables and keys. The coverage then moves to SQL. Students work from existing databases, either designed on paper so that the students can create the tables or starting with an already implemented database (e.g., in Access). While developing proficiency with using SQL, students also work with examples of well-designed relational databases. The panelists using this approach found that students were both more prepared to understand modeling concepts with a prior hands-on SQL background and were more motivated to learn modeling and design issues once they obtained a good sense of what a database is. The SQL-first approach is also consistent with a curriculum in which students usually or sometimes take the database course before the systems analysis and design course. If the curriculum provides few abstract modeling exercises prior to the database course, students may be overwhelmed by the modeling-first approach. The downside, as mentioned in the previous section, is that students develop one view of what a database is, the relational database model. One view, however, is better than no view for many students.

The use and the manipulation of data with SQL prior to modeling facilitates the professor's ability to illustrate the more subtle modeling issues and helps students to conceptualize data modeling, normalization, and key related issues better. Without the knowledge of data manipulation tools, such as SQL, the abstract nature of some components of data modeling are not fully understood by students. Many types of students may benefit from starting with the more concrete examples

that SQL enables an instructor to represent in the classroom before moving to the more abstract concepts involved in data modeling and its ties to organizational needs. These students include the technically-oriented students that migrate towards an IS major and non-traditional or first-generation students with less exposure to abstract thinking. Thus, a wide variety of students may benefit from the teaching of SQL earlier in the database course.

Another way to handle this more practically-oriented learning preference is to present basic data manipulation in introductory courses. In some curricula, database access, using SQL or Query-By-Example (e.g., Microsoft Access) is taught in courses prior to the database course (e.g., in the IS principles course or programming classes). In this case, students can refresh their database programming knowledge quickly and the teaching of data modeling can be enriched by simple examples of how data can be accessed. This option does not work as well in institutions with many transfer students from community colleges or from other majors within the institution. In these cases, the institution generally accepts a variety of substitutes for the introductory courses, many of which may not include this material.

MODELING INTEGRATED WITH SQL

Other instructors found that the optimal situation ocurs when the student can learn SQL and modeling in an integrated fashion. The benefit to this approach is that the students learn both the tangible SQL skills and the more abstract skills of modeling hand in hand. As the student learns about entities, attributes, and identifiers they learn to create tables, define attributes and select primary and foreign keys. This approach leads to students having an intertwined knowledge of modeling and SQL and contributes to their understanding of how these two components of database design and administration work together. This learning approach is akin to the prototyping systems development methodology.

The drawback to this integrated presentation approach is that it can blur the line between logical and physical design. It directly ties a data model to the relational database management system. This link, in turn, may make it difficult for a student to create data models independent of a specific type of DBMS. Without this independence, students tend to view data modeling more as a step towards IS and database development rather than as a tool to elicit business data requirements during database analysis and design efforts.

Encouraging students to experiment with sample data as they learn data modeling often helps them to understand how the abstract decisions they make about their data model will really work. Differences in user/analyst communication or within a student group are often uncovered when sample data is used to make the data model more concrete. If the students understand that their use of primary and foreign keys enable the application of the data model to the relational physical design, the value of the logical design can be emphasized. At the same time, the student can establish a physical design and begin, through the use of SQL, to form the necessary mental link between the logical and physical design. The predominance of SQL and the relational model probably result in few professors taking the data model to a hierarchical or network physical design, but well designed examples employing sample data could further establish the understanding of logical design and physical design. In this way, an integrated presentation approach to modeling and data manipulation (via SQL) can be leveraged by professors to draw out the interconnectedness of logical and physical design.

IV. DATABASE RESOURCES

The panel made it clear that database is taught from a variety of perspectives. The IS2002 Model Curriculum (Gorgone et al. 2003) is a starting point as each educational institution delivers database-related course content in its own way, and each instructor uses his/her own pedagogical style. What unites the course offerings are the resources available for teaching. To help instructors no matter which combination of macro (Section II) and micro (Section III) views

they follow in their courses, Appendix I presents a list of available resources. The resources are based on panel discussions, luncheons at AMCIS attended by database instructors , manuscripts, websites, listservs, and professional organizations. The resources cover more than the two topics discussed by the panel. The topics range from software (selection, installation, and use) to specific projects, assignments, and cases for use in the classroom.

V. CONCLUSION

This panel discussed the issues that need to be considered in deciding where to place the database course in the IS curriculum and the order in which data modeling and data manipulation should be presented. The database course does not leverage its full potential and is not of the most benefit to the student when taught in isolation. Rather, the panel concluded that the IS curriculum of an institution should be designed to meet the fundamental goals of the school and the specific skills the institution's students should have when they graduate. Database is but one course in the curriculum, which in itself should not be viewed as a set of isolated courses but instead a rich knowledge platform from which students are able to become successful IS professionals.

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APPENDIX I. ANNOTATED BIBLIOGRAPHY ON DATABASE RESOURCES

Editor's Note: The references in this Appendix contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that

1. these links existed as of the date of publication but are not guaranteed to be working thereafter.

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PANEL DISCUSSIONS

The education track at the Americas Conference on Information Systems (AMCIS) typically runs a panel session on database-related topics. More focused or regional academic conferences such as Information Systems Educators Conference (ISECON), Southern Association for Information Systems (SAIS), International Academy of Information Management (IAIM) and the International Resource Management Association (IRMA) often schedule panel discussions or allow for informal roundtable gatherings for database topics.

LUNCHEONS

At many of the major IS academic conferences a luncheon is held for database instructors to get together and create a knowledge network. Monica Garfield chairs this effort and Wiley and Sons sponsors it. Look for Teradata University Network to become more involved in future conferences.

WEBSITES

Data and Information Quality website (http://mitiq.mit.edu/)

> MIT's Information Quality website includes information about MIT's information quality education programs and links to many data and information quality resources. The link to the Total Data Quality Management Program, which includes a number of papers available for download, and the link to the International Conference on Information Quality website are particularly relevant.

IS2002 Model Curriculum Website (http://www.is2002.org)

> This website contains materials related to the IS2002 model curriculum, often in both html and PDF formats. It includes a description of the overall curriculum, revision efforts, sample course descriptions, and learning units among other resources. IS2002 is an industry and academic collaborative effort at specifying a model curriculum for an information system professional's educational preparation.

ISWorld Database Educator's Resource (http://www.magal.com/iswn/teaching/database/)

> This portion of the ISWorld website provides materials related to knowledge, syllabi, cases, and books for database educators. Faculty can browse the resources already available and/or submit work for possible publication on this site.

Teradata University Network (www.teradatauniversitynetwork.com/)

> This site for faculty, and the companion Teradata Student Network site, (www.teradatastudentnetwork.com) provide a knowledge base and software resources for teaching database management, data warehousing, business intelligence, and decision support systems. The site contains a variety of resources, including: software (e.g., Teradata SQL Assistant/Web Edition with data sets from several leading textbooks, and MicroStrategy); course syllabi, lecture notes, and exercises; case studies; 'white papers'; and research presentations. Although available at no cost, faculty members must register for this site.

SQL Online Resources

A Gentle Introduction to SQL (http://sqlzoo.net/)

> This United Kingdom site provides a series of tutorials and documents related to using SQL. It also provides links to other resources, including a Gentle Introduction to XML.

Database Tutorials (http://www.geekgirls.com/menu_databases.htm)

This site provides several image-filled explanations of database design in simple English terminology. The site also contains resources for many Windows-based applications and for Internet development.

Interactive Online SQL Training (http://www.sqlcourse.com)

This introductory SQL tutorial (with industry advertising) provides easy-to-understand instructions for using SQL and also allows practice with SQL through the use of on-line SQL interpreter. This SQL tutorial currently supports a subset of ANSI SQL.

PROFESSIONAL ORGANIZATIONS

ACM SIGMOD – ACM Special Interest Group on Management Of Data (http://www.acm.org/sigmod/)

The ACM Special Interest Group on Management of Data is an association for students and professionals interested in research, development, and deployment of solutions to large-scale data management problems. SIGMOD membership; is an almost equal mix of people from industry and from academia. SIGMOD sponsors an annual conference that is regarded as one of the most important in the field.

ACM SIGKDD – ACM Special Interest Group on Knowledge Discovery in Data (http://www.acm.org/sigs/sigkdd/)

SIGKDD's primary mission is to provide a forum for advancement, education, and adoption of the "science" of knowledge discovery and data mining from all types of data stored in computers and networks of computers. SIGKDD promotes basic research and development in KDD, adoption of "standards" in the market in terms of terminology, evaluation, methodology and interdisciplinary education among KDD researchers, practitioners, and users.

AIS SIGDSS - AIS Special Interest Group on Decision Support, Knowledge and Data Management Systems (http://www.sba.oakland.edu/faculty/sugumaran/sigdss/)

AIS SIGDSS is a forum for AIS members to discuss, develop, and promote issues, ideas, and research related to using information technologies to support decision-makers and improve decision processes in businesses and organizations.

AIS SIGED: IAIM - AIS Special Interest Group on Education – International Academy of Information Management (http://www.iaim.org/)

The objective of IAIM is to provide a forum to exchange ideas, techniques, and applications. This objective is realized through activities and publications. IAIM sponsors the International Conference on Informatics Education Research in December. IAIM also sponsors the Alpha Iota Mu honor society for information systems majors as well as the *Journal of Informatics Education Research (JIER)* which publishes refereed articles addressing excellence in MIS education and promotes teaching what an information professional needs to know to manage IS effectively -- including technical skills, managerial skills & frameworks.

AITP EDSIG : The Education Special Interest Group of Association of Information Technology Professionals (http://www.aitp-edsig.org/)

The Education Special Interest Group of AITP is dedicated to IS education, and its mission is to provide IS educators with the latest research in educational techniques, processes, and technology. EDSIG publishes the Journal of Information Systems

Education (JISE), a quarterly refereed journal, and the Information Systems Education Journal (ISEDJ), a refereed online journal. An important ongoing activity of EDSIG is the Information Systems Education Conference (ISECON), an annual conference since 1982 dedicated to Information Systems Education.

Data Management Association International (DAMA) (http://www.dama.org)

DAMA, The Data Management Association International, is an international association of data resource management professionals with chapters and Members-At-Large around the world. Data resource management is the development and execution of architectures, policies, practices and procedures that properly manage the full data lifecycle needs of an enterprise. DAMA sponsors an annual Symposium on Data and Information Management. DAMA has a committee working on curriculum guidelines for teaching data management in post-secondary education.

IEEE Technical Committee on Data Engineering (TCDE) (http://www.computer.org/tab/tclist/tcde.htm)

The Technical Committee on Data Engineering (TCDE) is concerned with the role of data in the design, development, management, and use of information systems. Issues of interest include database design; knowledge of the data and its processing; languages to describe data, define access, and manipulate databases; strategies and mechanisms for data access, security, and integrity control; and engineering services and distributed systems. The TC sponsors the Data Engineering Conference and cosponsors the International Conference on Very Large Data Bases. It is involved with other conferences, symposia, and workshops, and publishes a quarterly newsletter.

The Data Warehousing Institute (TDWI) (http://www.dw-institute.com/)

The Data Warehousing Institute™ (TDWI), a division of 101communications, provides in-depth education and research in the business intelligence and data warehousing industry through several annual meetings and journals. TDWI educates business and information technology professionals about the strategies, techniques, and tools required to design, build, and maintain business intelligence and data warehousing solutions.

ABOUT THE AUTHORS

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Monica J. Garfield is Assistant Professor of Computer Information Systems at Bentley College. She is the editor of the ISWorld Database Educator's Resource and a member of the Teradata University Network advisory board. She teaches database at the undergraduate and graduate level. Her research focuses on the use of IT to enhance creativity, the impact of technology on group interactions and knowledge creation. Her work appears in *Information System Research, MIS Quarterly, Communications of the ACM* and *Journal of Management Information Systems*. She holds an AB from Vassar College, an MBA and MS from Boston University and a PhD in MIS from the University of Georgia.

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courses. He is a co-founder of the Association for Information Systems, International Conference on Information Systems, and SIGMIS (within INFORMS). He holds a PhD in operations research from Cornell University, and was on the faculties of Case Western Reserve and Indiana Universities prior to joining the University of Dayton.

Mary Prescott is Director of Graduate Programs for the John H. Sykes College of Business and Associate Professor of Information and Technology Management at The University of Tampa. Mary manages the Masters of Business Administration and Masters of Science in Technology and Innovation Management at UT. She is also a co-author of *Modern Database Management,* with Jeffrey Hoffer and Fred McFadden*.* Her research is in the adoption and implementation of emerging information technologies.

Bruce Rollier is Associate Professor of MIS at the University of Baltimore. He received his PhD in Information Systems from New York University in 1989, after a 30-year career with IBM, Control Data Corporation, and the late Arthur Andersen and Co. He was a Visiting Professor for two years at Morgan State University sponsored by IBM's Faculty Loan Program; in the second year he also served as Assistant Dean. His chief research interests are in data warehousing, international information systems, and cognitive research. He also holds an MBA from Northwestern University's Kellogg School of Management.

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Kevin Lee Elder is Assistant Professor of Information Resource Management at the Air Force Institute of Technology at Wright Patterson Air Force Base where he teaches courses in eBusiness, enterprise architecture, database, and systems analysis and design. He served as Track Chair for the Special Education Track at AMCIS in 2001 and 2002. He previously served as editor for the Journal of Information Systems Education and on the Board of the Education Special Interest Group of the Association for Information Technology Professionals. His work appears in the J*ournal of Information Assurance Security and Protection* and the J*ournal of Information Systems Education.* He holds a B.S. and M.S. from California State University Fresno and a Ph.D. in MIS from the University of Arizona.

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