Database Design: What HIM Professionals Need to Know

by Robert J. Campbell, EdD

Abstract

Database technology has been a familiar tool in the operations of most HIM departments and a very basic understanding of this technology has usually been adequate enough to allow HIM professionals to work effectively with vendors or information services staff.

As database technology moves from the task of supporting paper systems to actually becoming the central digitized health information system, a "basic understanding" becomes inadequate.

To embrace the digitization efforts, AHIMA has adopted an initiative called e-HIM™. For e-HIM to be successful, it will be essential for HIM professionals entering the work force to have the necessary database skills to perform their jobs. The important question to ask is: What are those skills? This paper presents the use of a Nominal Group Technique to identify a group of HIM professionals who work with databases to identify a set of essential database skills.

Introduction

Garfinkel reports that the United States has become a nation of databases.[1] Today, databases are being used to track credit card transactions, phone calls, ATM withdrawals, and bank account balances. With the disclosure that more than 98,000 Americans a year die from medication errors, the healthcare industry is also quickly adopting the use of databases to track everything from prescription medications and laboratory tests to patient outcomes.[2] The reason for the shift is that until now, most medical information has been recorded on paper, a practice that has led to a great deal of waste, duplication, and inappropriate utilization of treatments.[3]

Recently, the US Department of Health and Human Services (HHS) announced plans to create a national database containing electronic medical records that track a person's interaction with the healthcare system from birth to death.[4] To stay current with the HHS proposal to digitize healthcare information, AHIMA has adopted a strategic plan called electronic health information management (e-HIM), which calls for the creation of practices that "ensure the availability of health information to

facilitate real-time healthcare delivery and critical health related decision-making for multiple purposes across diverse organizations, settings, and disciplines."[5] These goals, although ambitious, will not come to fruition unless healthcare information is stored accurately, reliably, and securely in well-designed computerized databases.

Relational Databases

Mon states that the most common form of database used in healthcare is the relational database. Relational databases can be used to track patient care in the form of treatments, outcomes of those treatments, and critical indicators of a patient's current state such as blood pressure, heart rate, and blood glucose levels.[6] Relational databases can also be used to interconnect with multiple informational systems throughout a healthcare facility. For example, a relational database in a cardiac care unit can be directly linked to a hospital's registration system. Upon registration, a newly admitted patient's demographic information is sent automatically to the cardiac database using Health Level 7 protocols. This eliminates the need for cardiac care clinicians to input patient information into the database, freeing them to concentrate on providing the patient with the best care possible.

Relational databases have the potential to eliminate paper storage and transfer of information and to answer important questions about healthcare efficacy rather than merely serving as an accounting mechanism. For example, diabetic patients sharing similar health risk factors (for example, slightly overweight, high HbA1c and fasting blood glucose readings) can be closely monitored to determine how different drugs (for example, Glucovance) help to control those factors. From an administrative and prevention standpoint, relational databases can be used to identify at-risk patients, for example, those who have a family history of aneurysms. Once identified, patients can be screened to prevent them from succumbing to a particular disease.

Needs for e-HIM Implementation

To ensure that the goals of e-HIM are met, competent health information management (HIM) professionals with the skills to design, develop, and maintain databases are clearly needed. However, Mon does not specify particular skills that would be required for development of useful relational databases.[7] Presently, instructors in the HIM field teach skills based on their own experiences. However, a current problem is that HIM academics and professionals have given no concise definition of the core set of database design skills that students graduating from HIM programs should possess.[8]

The fundamental premise of the current investigation is that clear identification of skills will not only prepare students to develop relational databases using Access and SQL, but to better manage databases for clinical care applications, computerized physician order entry systems (CPOE), data warehouses, and data marts. This investigation was inspired by comments made to the author while conducting site visits and informational interviews with database designers at various healthcare facilities. Many of the database designers voiced the opinion that students graduating from HIM and business programs do not have the skills or knowledge to deal with the complexity of organizing healthcare information into functional databases that could be used to improve the healthcare process. This further supports personal communication and comments made in the *Journal of Database Management* by Frost, who describes the problem as not only a lack of definition, but one of inadequate resources: "If database texts are so good, why do our graduates emerge so poorly prepared for positions in industry?"[9, 10] Furthermore, "Are the basic skills taught in textbooks the real skills students need?" The goal of this research project has been to identify the exact database skills that students need to be successful in database design and management.

To respond to this challenge, this investigation used a nominal group technique (NGT) to generate a list of database skills that would serve as the foundation for a course in database design and management.[11] The author hypothesized that having a panel of experts identify this select set of skills would better prepare students to deal with the challenges they would face as practicing HIM professionals. In addition, a composite list of skills identified by experts in the field would serve as a means of linking database theory to current practice.

Method—Part I (Identification of Top 20 Skills)

Participants and Procedures

The first step in implementing NGT was the identification of a group of HIM database professionals currently working in the greater Pittsburgh area who could serve as a panel of experts. Experts had roles representative of those students in a database design course would assume as practicing HIM professionals. They included database designers, data analysts, business analysts, decision support analysts, data resource analysts, managers of data resource teams, and directors of information technology. The experts were employed by healthcare facilities representative of the HIM profession and came from the following healthcare entities: HighMark BlueCross/BlueShield, HealthAmerica, The Children's Institute, Mercy Hospital, and the University of Pittsburgh Medical Center.[12-16] Experts were contacted by phone and asked whether they would be willing to participate in the project and how long they had been working with databases in a healthcare setting. To qualify for the study, the expert had to have worked with databases in a healthcare setting for two or more years. From this process, a total of 10 experts were identified.

To begin the NGT process, the author asked the experts the following question: What are the most important skills students should possess after completing a database design and management course? To avoid bias, the investigator chose to allow the experts to generate the skills rather than using AHIMA's curricular knowledge clusters (Appendix A). The experts' independent identification of skills also served to validate the more generic knowledge clusters.

Experts were asked to e-mail their answers to the author. From their responses, a set of 50 database skills was generated (Table 1).

Next, the experts met as a group. They were asked to examine the list of skills for completeness and consistency and then identify and rank the 20 most important skills from the composite list of 50 skills that had accrued via the e-mail solicitation method. Compilation of these 20 skills achieved the following two goals:

1. identification of a set of skills representing the core knowledge HIM professionals need to have to be productive when working with databases on a daily basis
2. identification of a skill set that could be taught to students enrolled in a 15-week database design and management course

First, the experts agreed that each of the skills represented an important task and that none of them needed to be removed. Next came the process of identifying and ranking the skills. To accomplish this task, experts were given a stack of 20 4 x 5.75-inch sheets of paper. Each sheet contained enough space for the expert to list a skill, its corresponding number, their name and title, any comments they wished to make, and the rank assigned to that particular skill.

To rank each skill following the procedures set forth by Delbecq et al., the experts were first asked to select the top 20 skills they felt students should acquire upon completion of a course in database design.[17] They were then instructed to write each skill on a separate sheet of paper. Once each sheet of paper contained a skill, the experts were asked to rank as 20 the skill they felt was most important. They were then asked to rank as 1 the least important skill. The experts proceeded in a round-robin fashion from highest to lowest until all selected skills were ranked. Once the experts completed their rankings, the skills sheets were tallied by the design team to determine the top 20 skills.

It is important to note that skills could be ranked in the following two ways. A skill could receive a score based on the rank given to it by each expert. The skill could also receive a score based on the number of experts who chose that skill as being important. For example, if the skill *Defining data elements* received rank scores of 13, 15, 17, 19, 10, 18, 13, and 16, it would have a total ranking score of 121 based on the singular rankings of eight experts. The score for this skill would read 8/121. If the score for the skill *Fluency in the SQL Command Lanquage* received ranking scores of 11, 10, 17, 13, 15, 10, 9, 14, and 8, it would have a total ranking score of 107 based on the singular rankings of nine experts. The total score for this skill would read 9/107. Therefore, the skill *Fluency in the SQL Command Language* would be ranked higher than *Defining data elements* because nine experts, rather than eight, felt it was an important skill for students to achieve. Table 2 lists the top 20 skills as rated by the panel of experts. The table identifies the skill, number of experts selecting the skill, and sum of the ranks assigned to that skill.

Results

In reviewing the list of the top 20 skills, it should come as no surprise that fluency in the SQL command language was rated 1. The SQL command language can be used to create, manipulate, and modify data stored in the most popular databases (SQL, Access, DB2, and Oracle). This skill will provide the database designer with the ability to work in a wide range of database environments.

Further examination of the identified skills bears out the fact that each can be explicitly placed into one of three categories: *database skills, definition and analysis skills,* and *database design techniques* (Tables 3 to 5). From the categorization process, it is evident that individuals entering into the HIM profession will need to have a specific set of skills that allow them to create, modify, and manipulate data using one of the more popular database products like SQL or Access. Furthermore, they will need to have a set of skills that enables them to determine end-user needs and define the data that will be used to create a working database. Finally, individuals will need to learn a set of skills that allow them to communicate effectively with the end user to identify goals and requirements for a database project. With a set of requirements and goals, individuals can then create a data model and normalize the model to enhance performance while using creative methods to develop a final product that satisfies the identified goals of the database project.

Critical Analysis of the List

Participants and Procedures

All members of the expert panel that identified the top 20 skills participated in the critical analysis portion of this investigation.

After they were presented with the list of the top 20 skills, the experts were asked to comment on the results. The author mediated the discussion. First, the panel was instructed to verbally comment on whether the skills contained in the list were redundant. Second, they were asked to comment on the utility and relevance of the skills in terms of preparing students for their future careers as database designers who can store, update, and manipulate information to answer critical healthcare questions. The author recorded the experts' comments online in outline form using pen and paper. Results were compiled immediately following the conclusion of the meeting.

Results

Redundancy. Several experts questioned whether skill 13, *ability to communicate effectively,* and skill 14, *ability to listen to and understand user requests,* were not so similar that they could be combined into one skill. After further discussion, it was agreed that *ability to communicate effectively* centers on a designer's ability to generate both oral and written communication, whereas the skill *ability to listen to and understand user requests* focuses on the capability to be patient and composed in order to really listen to what end users are saying. Therefore, these skills represent two distinct capabilities that a designer must possess to effectively design a database.

Experts agreed that the ability to listen to and understand what the end user wants provides information and feedback to the designer, which in turn provides the raw information needed to uncover deeper issues relating to how the information in the database will be used. For example, what reports will need to be generated, and what outcomes need to be tracked? To uncover these deeper issues, the designer must be able to communicate at a high level in order to develop both general and structured questions that focus directly on the needs of the end user. Furthermore, once the end user's data requirements have been identified, the designer will need to document those requirements using entity-relationship modeling techniques. Essentially, these two skills share a symbiotic relationship, with each skill providing the other with important information until the needs of the end user have been fully elucidated.

Relevance. Another discussion between the experts involved the importance of database design and data manipulation. Several of the experts working in a hospital setting emphasized the importance of building a database from the ground up, using the technique they described as end-user analysis. On the other hand, several experts representing healthcare insurers were especially attuned to the need for the database designer to have a well-developed set of data manipulation skills. These individuals felt that it was imperative to have well-designed databases that would allow clinicians to efficiently retrieve the information for generating a report or satisfying an administrative request.

Both groups reached a consensus via the understanding that good design, especially excellent end-user analysis, leads to the creation of a database that contains the information end users will need to satisfy not only present information needs, but future information needs as well. Several of the experts called this *design flexibility* or *future proofing.* Experts also agreed that knowledge of how to manipulate data within a database leads to a greater understanding of the types of questions to ask end users in terms of how the information will be searched for in a database. For example, will information be searched for by diagnosis related group or common procedure terminology code? Will cost fields need to be calculated each night? This information helps the designer to identify what type of information will be represented in tables (for example, physician demographics, patient demographics, treatments), data types assigned to fields within the tables, relationships among the tables, and whether special tables such as aggregation tables need to be implemented within the design. The experts agreed that good design supports data manipulation, and knowledge of data manipulation techniques supports good database design; it is a symbiotic relationship. At the close of the discussion, the experts agreed that the final list identifies a knowledge base that will provide students with the skills they need to become productive HIM professionals.

Conclusion

The effort to identify a list of database skills for the prospective HIM professional to acquire is important for several reasons, the most important being that one of the goals of a database is to track and monitor whether patients are receiving the care they need to get well. This means measuring how well physicians follow practice guidelines and procedures. If the database is set up properly, reports generated from the information stored in it will illuminate which guidelines and physician practices lead to better outcomes, as well as identify physicians who need further training and guidance in how to care for their patients. If the database is not designed properly, this type of reporting is not possible. Moreover, an improperly designed database could lead to the generation of inaccurate results, redundancy of data, wasted time and effort, and perpetuation of medical errors. Acquisition of this skill set will distinguish HIM professionals from their counterparts in the business world in two distinct ways:

1. The structure and relationships of healthcare information are unique and complex. In many instances, patient demographic information can be related to multiple diagnoses, which are then linked to multiple procedures performed by multiple physicians prescribing multiple drug interventions. The ability to handle this complexity will allow HIM professionals to rise above their peers in the business world. Furthermore, many of the database designers who served as experts for this study acknowledged that if individuals are able to design databases that store and manage healthcare information, they will be able to work in other fields with equal aplomb. The experts felt that individuals transitioning from business to healthcare would do so with great difficulty.
2. As previously discussed, database designers in the healthcare sector must have equal facility in both database design and data manipulation. Acquisition of the defined skill set will prepare HIM professionals to handle both tasks.

The skills listed in Table 2 are not definitive and by no means comprehensive; however, they are reflective of what HIM professionals in real-world healthcare settings feel should be taught in a database design and management class. More important, they represent skills that currently practicing HIM professions feel are indicative of what makes them productive in today's data-driven healthcare sector. It is hoped that this endeavor will spark discussion and debate among HIM professionals and academics about how AHIMA-accredited educational institutions are preparing future professionals in the field and what is being taught in classes designed to prepare them. Discussions of this type can only serve to enhance the discipline that students in HIM programs must attain to graduate, which can directly affect how databases and other technologies can be used to reduce patient hospital visit time, improve documentation, eliminate waste and redundancy, and reduce costly medical errors. Is that not worth the time and effort?

One limitation of NGT is that it can only capture the thoughts and feelings of the experts involved in this group decision-making process. If regional, geographical, and institutional differences exist in the processes being measured, gaps will exist in the gathered information. Great care was taken to ensure that individuals working in database design roles in representative healthcare entities were selected to take part in this study, therefore making it safe to assume that the findings are generalizable to all HIM professionals assuming database design roles in healthcare facilities across the United States.

If the HIM profession and its certified educational programs and institutions as a whole do not attempt to achieve the same level of precision as the medical field does with patient guidelines and standards of care through the specification of skill sets prospective HIM professionals need to acquire, the

goals of e-HIM will never come to fruition. These goals will become the essence of the Buddhist phrase, "fingers pointing at the moon." Meaning we should not mistake these goals for the actual skill sets themselves.

Robert J. Campbell, EdD, is an assistant professor at the Rangos School of Health Science at Duquesne University in Pittsburgh, PA.

Notes

1. Garfinkel, Simson. *Database Nation: The Death of Privacy in the 21st Century.* Sebastopol: O'Reilly & Associates, Inc., 2000.

2. Kohn, Linda T., Corrigan, Janet, Corrigan, J., and Donaldson, Molla. *To Err is Human: Building a Safer Health Care System*. Washington, DC: National Academy Press, 2000.

3. Institute of Medicine. *Crossing the Quality Chasm.* Washington, DC: National Academy Press, 2001.

4. Anderson, Lauren B. "HHS Unveils Electronic Plan for Tracking Medical Records; System Would Allow Access to Patient Data by Doctors, Hospitals, Insurance Firms." *The Wall Street Journal* (July 2, 2003).

5. American Health Information Management Association. "A Vision of the e-HIM Future." Available at http://library.ahima.org/xpedio/groups/public/documents/ahima/bok1_020477.pdf.

6. Mon, Donald. T. "Relational Database Management: What You Need to Know." *Journal of AHIMA* 74, no. 6 (2003): 40–45.

7. Ibid.

8. A comprehension literature review was completed by the author using the following bibliographic databases: ABI/Inform Dateline, ABI/Inform Global, ABI/Inform Trade & Industry, CINAHL, MEDLINE, and the IEEE Digital Library. The goal of the literature review was to determine if any articles describing a set of skills students should acquire in a database design and management course had been written; no articles of this type were found. The literature review located a number of articles written about specific skills attributed to the design process (for example, normalization, conceptual modeling); some of the skills discussed in the articles were also identified by the panel of experts as being the skills that an HIM professional must acquire in a database design and management course. The skills identified by the experts were placed into three categories: database skills, definition and analysis skills, and database design techniques. To save time and space and provide the reader with examples of the types of articles found in the literature review, citations for selected articles appear under the appropriate heading in Appendix A.

9. Raymond D. Frost. Personal e-mail, 26 September 2003.

10. Frost, Raymond D. "Teaching Design to Solve Business Problems." *Journal of Database Management* 8, no. 3 (1997): 37-38.

11. A full description of NGT is beyond the scope of this article. For more information, please see Delbecq, Andre L., Andrew H. Van de Ven, and David H. Gustafson. *Group Techniques and Program Planning: A Guide to Nominal Group and Delphi Processes.* Glenview, IL: Scott, Foresman and Co., 1975.

12. HighMark BlueCross/BlueShield is a Pennsylvania-based nonprofit corporation that provides a range of insurance products to approximately 23 million members in the state and across the nation.

13. HealthAmerica is a leader in providing innovative health benefit solutions to companies in Pennsylvania and Ohio. Health America is headquartered in Harrisburg, PA, with offices located in Pittsburgh, State College, and Erie. HealthAmerica is one of the largest health insurance organizations in the country and currently insures nearly 10,000 employer customers and more than 600,000 members through a provider network of more than 13,000 network doctors and 132 hospitals.

14. The Children's Institute is a regional leader in providing pediatric rehabilitation services. The Institute provides individualized treatment programs along a broad continuum of care: inpatient care, outpatient care, transitional and sub acute care, home care, and The Day School.

15. Mercy Hospital is a licensed acute care hospital. With 430 inpatient beds, Mercy Hospital offers specialty adult and pediatric emergency services, a trauma center, and a pediatric and adult burn center. Mercy is also designated as a Level I Regional Resource Trauma Center.

16. University of Pittsburgh Medical Center is one of Western Pennsylvania's leading healthcare systems and a consortium of more than 20 tertiary care, specialty, and community hospitals. It also known throughout the United States as one of the largest nonprofit integrated healthcare systems that has been consistently ranked by *U.S. News and World Report* as the best of the best in the publication's annual hospital ratings guide.

17. Delbecq, Andre. L. et al. *Group Techniques and Program Planning.*

Table 1: Initial List of Database Design Skills

Database Design Skills	
1. End-user analysis	26. Ability to analyze end-user workflow and integrate analysis into database design
2. Defining data elements	27. Ability to interpret and respond to error messages generated in Access and SQL
3. Ability to perform data retrieval and reporting	28. Ability to adapt to changing database design issues
4. Thorough understanding of the relational model	29. Ability to perform proper indexing to enhance query performance
5. Ability to partition data	30. Ability to perform enhanced entity relationship diagramming
6. Ability to normalize data	31. Ability to back up and restore a database
7. Ability to read the data dictionary	32. Ability to identify common database failures
8. Fluency in the SQL command language	33. Ability to control database for concurrent access
9. Ability to use the open database connectivity administrator	34. Ability to tune database for performance
10. Ability to reference and alter dates	35. Ability to manage data quality
11. Using Access and SQL: Knowledge of how to create tables, queries, forms, and reports and how they are used, created, and interrelated	36 Ability to design and develop a data warehouse
12. Ability to secure databases (HIPAA)	37. Ability to use online analytical processing tools
13. Ability to create conceptual, logical, relational models and convert them into a physical model	38. Ability to understand a solid design and implementation methodology (Spiral Methodology)
14. Ability to allocate disk space for a database	39. Ability to document security integrity
15. Understand how networks operate to ensure access to all who need the database	40. Ability to articulate and flow chart how data integrity will be maintained
16. Ability to perform denormalization	41. Knowledge of the most common large-scale database software programs (Oracle, Sybase, Informix, Microsoft SQL, Pervasive SQL)
17. Ability to create and use if/then statements	42. Ability to creatively solve problems
18. Ability to perform entity-relationship diagramming	43. Knowledge of computer programming
19. Ability to create views customized to the needs of various levels of users	44. Knowledge of how medical charges are billed
20. Ability to create calculations and aggregate functions within queries	45. Ability to listen to and understand user requests
21. Ability to test the database to ensure relationships are correct and needed queries and reports can be produced	46. Knowledge of proper customer service
22. Ability to perform right, left, union, and equi-joins and understand the different results they return	47. Exposure to existing commercial clinical database systems
23. Ability to communicate effectively	48. Experience interfacing databases with Web pages
24. Ability to document database design processes	49. Ability to work as a member of database design team

25. Ability to perform flow charting	50. Knowledge of the difference between data marts and data warehouses

Table 2: List of Top 20 Skills Identified by Expert Panel

Skill	Number of Experts Selecting the Skill (10 Possible)	Sum of Ranks Assigned to the Skill
1. Fluency in the SQL command language	9	107
2. Defining data elements	8	121
3. Needs analysis/end user analysis. Determine how the database will meet the needs of the end users. For example, physicians may want to track patient vital signs, while administrators may want to track physician performance. Did they follow guidelines? Did patients recover faster?	7	129
4. Ability to normalize data	8	119
5. Ability to analyze end-user workflow and integrate analysis into database design	8	110
6. Use Access and SQL to create, tables, queries, and forms	8	100
7. Ability to perform data retrieval and reporting	8	74
8. Ability to perform various joins and understand their results	7	77
9. Ability to create and use if/then statements	7	62
10. Ability to create calculations and aggregate functions within queries	7	60
11. Ability to creatively solve problems	7	57
12. Ability to manage data quality	7	43
13. Ability to communicate effectively	6	106
14. Ability to listen to and understand user requests	6	93
15. Knowledge of the most common database programs	6	64
16. Ability to perform proper indexing to enhance query	6	43

performance		
17. Ability to create conceptual, logical, relational models and convert them into a physical model	5	84
18. Ability to identify common database failures	5	39
19. Ability to interpret and respond to error messages generated in Access and SQL	5	35
20. Ability to secure databases	5	32

Table 3: Database Skills

Fluency in the SQL command language
Use Access and SQL to create tables, queries, and forms
Knowledge of common database programs
Ability to perform data retrieval and reporting
Ability to perform various joins and understand their results
Ability to create if/then statements
Ability to create calculations and aggregate functions within queries
Ability to perform proper indexing to enhance query performance
Ability to secure databases
Ability to interpret and respond to error messages in Access and SQL

Table 4: Definition and Analysis Skills

Defining data elements
Needs analysis/end-user analysis.
Ability to analyze end-user workflow and integrate analysis into database design
Ability to manage data quality

Table 5: Database Design Techniques

Ability to normalize data
Ability to create conceptual, logical, relational models and convert them into a physical model
Ability to communicate effectively
Ability to listen to and understand user requests
Ability to creatively solve problems
Ability to identify common database failures

Appendix A

References Relating to Database Skills

Edison, Betty. "Teaching Information Professionals About Database Design." *Database* 13, no. 1 (1990): 33–37.

Lee, Frances. M. "Data and Information Management." In *Health Information Management: Concepts, Principles and Practice*. Kathleen M. LaTour and Shirley Eichenwald (Editors). Chicago: American Health Information Management Association, 2002, pp. 83–98.

McLendon, Kelly and Carol Fetters. "Relational Databases—The Foundation of Today's Data Analysis." *Journal of AHIMA* 66, no. 9 (1995): 48–50.

Mon, Donald T. "Relational Database Management: What You Need to Know." *Journal of AHIMA* 74, no. 6 (2003): 40–45.

Willett, Delores A. and Min. F Teo. "Fundamentals of Relational Database System Design for Assessors." *Assessment Journal* 3, no. 3 (1996): 45–56.

References Relating to Definition and Analysis Skills

Alm, Irma. "Designing Interactive Interfaces: Theoretical Considerations of the Complexity of Standards and Guidelines." *Interacting With Computers* 15, no. 1 (2003): 109–119.

Ling, Liu, Calton Pu, and Duncan D. Ruiz. "A Systematic Approach to Flexible Specification, Composition, and Restructuring of Workflow Activities." *Journal of Database Management* 15, no. 1 (2004): 1-40.

Polson, Peter G. et al. "Cognitive Walkthroughs: A Method for Theory Based Evaluation of User Interfaces." *International Journal of Man-Machine Studies* 36 (1992): 741–773.

Shakir, Abdul-Malik. "Tools for Defining Data." *Journal of AHIMA* 70, no. 8 (1999): 48–53.

Shankaranarayan, Ganesa, Mostapha Ziad, and Richard Wang. "Managing Data Quality in Dynamic Decision Environments: An Information Product Approach." *Journal of Database Management* 14, no. 4 (2003): 14–32.

References Relating to Database Design Techniques

Artz, John. "The Database Designer Is a Person Too!" *Journal of Database Management* 5, no. 3 (1994): 31–34.

Batra, Dinesh and S. R. Antony. "Novice Errors in Conceptual Database Design." *European Journal of Information Systems* 3, no. 1 (1994): 57–70.

Batra, Dinesh and George Marakas. "Conceptual Data Modelling in Theory and Practice." *European Journal of Information Systems* 4, no. 3 (1995): 185–194.

Bock, Douglas B. "Entity-Relationship Modeling and Normalization Errors." *Journal of Database Management* 8, no. 1 (1997): 4–13.

Buelow, Robert. "The Folklore of Normalization." *Journal of Database Management* 11, no. 3 (2000): 37–42.

Weber, Ron. "Conceptual Modeling and Ontology: Possibilities and Pitfalls." *Journal of Database Management* 14, no. 3 (2003): 1–20.

AHIMA is the accrediting body for associate and baccalaureate degree programs in HIM. In 1996, AHIMA created a set of models that were designed to guide HIM programs in developing curricula to meet the demands that would be placed on HIM professionals in the 21st century. Each model consists of 11 knowledge clusters, with each cluster further subdivided by a set of knowledge units. Each unit is assigned a competency level indicating the level of knowledge and expertise a student should develop.

Competency levels range from one (awareness) to five (skilled use). Most relevant to the discussion is the knowledge cluster information technology. Within this cluster are the knowledge units data, information, file structures, data security, and data retrieval. Each unit has been assigned a competency level of 5 and is further subdivided into a set of smaller units. The knowledge cluster information technology and the aforementioned knowledge units are important because they represent AHIMA's attempt to define a set of competencies that closely resemble the set of skills HIM professionals must achieve to be considered competent in database design and management. However, they can be considered only guideposts or markers because they make no attempt to capture or reflect the skills that are most needed by HIM professionals in the area of database design.

Therefore, the design team felt that it was imperative to develop a list of skills that would make the HIM professional competent in database design and management. Furthermore, because these knowledge clusters are merely guides to what knowledge a student must acquire, what is taught in the classroom will be dictated by the idiosyncratic whims of educators who feel that what they present in class satisfies the competencies set forth in the knowledge clusters. With an accurate definition of the skills students must acquire in a database design course, educators will have a definitive list of skills that students need to acquire by the end of the course.