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## A Recommendation for A Professional Focus Area in Data Management for the IS2002 Information Systems Model Curriculum

**Herbert E. Longenecker, Jr.**  
University of South Alabama  
Mobile, AL 36688 USA

**David M. Yarbrough**  
Northrop-Grumman, Inc.  
Pascagoula, MS 39568 USA

**David L. Feinstein**  
University of South Alabama  
Mobile, AL 36688 USA

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# A Recommendation for a Professional Focus Area in Data Management for the IS2002 Information Systems Model Curriculum

Herbert E. Longenecker, Jr.  
hlongenecker@usouthal.edu  
Computer and Information Sciences  
University of South Alabama  
Mobile, Alabama 36688 USA

David Yarbrough  
david.yarbrough@ngc.com  
Northrop Grumman  
Pascagoula, Mississippi 39568 USA

David L. Feinstein  
dfeinstein@usouthal.edu  
Computer and Information Sciences  
University of South Alabama  
Mobile, Alabama 36688 USA

## Abstract

IS2002 has become a well defined standard for information systems curricula. The Data Management Association (DAMA 2006) curriculum framework defines a body of knowledge that points to a skill set that can enhance IS2002. While data management professionals are highly skilled individuals requiring as much as a decade of relevant experience before being hired, principles of the profession are a good fit with the requirements for an information systems analyst. The life-cycle relationships of data management professionals to other IT professionals suggest that information systems education and experience can provide an excellent career path to data management. Based on these observations recommendations are made to add a new professional emphasis area in data management and to add data quality, architecture and metadata concepts and practices to the IS2002 learning units.

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## 1. INTRODUCTION

In both the IS'97 (Couger et al 1994, 1997; Davis et al 1997) and IS2002 (Gorgone et al 2002) Model Information Systems Curriculum Models the focus of the programs was the educating of students who would have the skills necessary for the development and deployment of Information systems:

*"Information Systems, as an academic field, encompasses two broad areas: (1)*

*acquisition, deployment, and management of information technology resources and services (the information systems function) and (2) development and evolution of technology infrastructures and systems for use in organization processes (system development)."*

The correctness of these assertions have led to the documents becoming the basis of IS accreditation standards (Gorgone and Lidtke 2002). In addition, the exit areas of the

model curricula define the curriculum exit skill areas defined in 1997 and reiterated in 2002. Also, the survey data of Landry (2000) confirmed by national survey with confirmatory factor analysis the validity of these areas.

Subsequently, the model has been utilized as the basis for developing assessment examinations for IS programs by the Center for Computing Education Research, the CCER (Landry et al 2003, 2004). The skill areas were used jointly by the CCER and the Institute for Certification of Computing Professionals (ICCP) certification, "*The Information Systems Analyst*" (McKell 2003, 2004).

IS'97 and IS2002 curricula are expressed by ten model courses and are further specified by Learning Units (LU) which are flexibly defined collections of goals and objectives which explain the outcomes expected for each course. These LUs can be mapped to courses at a given university in order to show compliance with the model, as well as to enable assessment. The learning units can be mapped to one or more than one university course. At each mapping there is some local objective that would be defined by the university.

The Data Management Association specified a framework for data management curricula (Henderson et al 2004). The document contains a very detailed analysis resulting in the statement of a body of knowledge describing the objects of the data management profession. The framework suggests that it would be appropriate to develop undergraduate curricula in data management to become part of the professional force exceeding 100,000 people nationally (Henderson 2004).

In this paper we examine the question of whether there should be an undergraduate curriculum furnishing graduates to the data management profession. And, if not, what are the alternatives. Indeed, we will advance and support the concept that there should NOT be an undergraduate curriculum specifically for data management. However, based on our analysis of the data management framework and the responsibilities of the mission of the IS curriculum, we propose a responsive alternative to enhance signifi-

cantly the IS curriculum while simultaneously opening a strong career path for data management professionals.

## **2. THE DATA MANAGEMENT PROFESSION**

The data management profession has members who are entrusted with the information of major organizations. Many if not most of these professionals work for large organizations and are charged with definition, development, and management of the mission-critical information stores of significant organizations of the world.

In a recent article (Perez 2006) the characteristics of data management professionals have been examined and are reflected in Figure 1. For the most part the profession seems to be comprised of very senior people 90% of whom have had more than 10 years of professional experience. However, only an average of 5 of those years has been with the responsibility for data management. Also, since the mean age of these professionals is approximately 45, it would seem that most of these professionals have been out of college for 15 to 20 years. That is, data management is NOT an entry level profession. Rather, it is a profession requiring immense experience and mature judgment. A significant fraction of these professionals have had 20+ years developing their current level of experience. These observations are relevant because it implies that the focus of curriculum probably should not be to focus on entry level professionals.

## **3. SKILLS COMPARISON OF INFORMATION SYSTEMS AND DATABASE ANALYST PROFESSIONALS**

During 2000 US faculty and professionals were surveyed (Haigood 2000) regarding the skill depth of database analysts, software engineers, and information systems professionals. For the list of skills surveyed respondents were asked to evaluate the relative skill depth required for their profession.

Database analysts are data management professionals. Software engineers most frequently have come from computer science

programs. Information systems analysts represent the graduates from IS programs. The meaning of the data in Figure 2 suggests that database analysts are very similar to IS analysts, except more skilled. On the other hand, there seems to be very little correlation of database analysts and software engineers. Figure 3 shows a specific correlation between IS analysts and database analysts. In both Figures 2 and 3 what is striking is the similarity of the two professionals.

That database analysts have higher skill expectations is not surprising since it is likely they have considerably more experience. What is also interesting is the possibility that with years of professional experience, the IS professional will mature and develop the sophistication of the database analyst. That is, the entry level IS professional may have a career path to the database analyst position, and by extension to the data management professional.

#### 4. ANALYSIS OF THE DAMA BODY OF KNOWLEDGE

One of the important contributions of the DAMA framework is the development of a body of data management body of knowledge. Clearly the body of knowledge begins to define the profession. In order to understand the body of knowledge we produced a hierarchical extraction of the body of knowledge by abstracting each major section of the body to a single phrase that was descriptive of the entire section. This abstraction is represented in Figure 4.

The framework uses a different ordering of the data portrayed in Figure 4. We observed that the data of figure 4 closely parallel a development life cycle. This is an important observation since the framework does not make this point. It is also important since it would be necessary for data-related-tasks to exist at each phase of the life cycle if the information systems professional were to migrate to the role of data management professional. Indeed, by inspection of Figure 4 many of the topics already are well defined in the IS curriculum.

Notably absent from the IS2002 curriculum are important areas recognized in the DAMA

body of knowledge. For example, Data Quality is absent from IS2002 (Strong 2005). Data warehousing, data security, and the concept of metadata are not defined, and should perhaps be added to the model curriculum.

#### 5. DAMA BODY OF KNOWLEDGE LIFE CYCLE RELATIONSHIPS

In Figure 5 we present a life-cycle representation consistent with the Capability Maturity Model of the SEI (CMMI Team 2002; CMU 2004) for systems and software engineering. We have added two additional rows in which we have inserted at appropriate locations in the life cycle the titles presented in Figure 4. Interestingly, we found a perfect fit for all of the components of the DAMA framework in a single row we entitled "Information Engineering" indicative of the developmental role implied. We believe that The INCOSE Body of Knowledge (INCOSE 2006) and the software engineering descriptions implied in the CMMI (2002) are represented adequately in Figure 5. DAMA through its framework clearly expresses professional "ownership" of the information engineering row of responsibilities in Figure 5. Likewise, INCOSE clearly identifies its professional "ownership" through its published body of knowledge, as does the SEI define a similar "ownership" for software engineering.. Indeed, systems engineers, like data management professionals are not entry level positions. They too require many years of experience.

#### 6. THE IS2002 SKILL SET

The IS2002 skill set is not positioned in life-cycle order. However, it is our observation that the skill set fully comprises rows 1, 2, and 3. That is,

Information Systems = {People + Systems + Information + Software} Engineering.

What we think this observation means is that in smaller organizations there is not budget for more than one information technology professional. In smaller organizations, consultants may fill the roles of these positions. In larger to medium organizations, the information systems professional probably fills all of the functions. However,

in larger organizations, there will be job descriptions for each of these rows. Indeed, there may be positions for only one or two cells of the matrix, e.g. a Data Modeling Specialist. It is therefore reasonable that the specialists take years to mature.

Therefore, it is reasonable to expect that the basic concepts and skills implied by the DAMA Framework be learned by beginning IS professionals to provide a foundation for entry level positions and future professional growth into data management positions. The additions to the Skill Set involve adding three new sub-skills as presented in Figure 6.

While the expressed skill set of IS2002 is broader than that expressed in Figure 5, it is the feeling of the authors that data management professionals as well as information systems professionals meet the criteria of the mission of IS (McNurlin and Sprague 1998)

*"to improve the performance of people in organizations through the use of information technology. ... Misunderstanding the necessity for supporting people leads to disastrous consequences: the focus MUST BE to develop excellent people focused business systems with inextricably woven information systems with related, appropriate, accessible data. People do the work of the organization! "*

### **7. SO, SHOULD THERE BE A SEPARATE DATA MANAGEMENT DEGREE PROGRAM?**

We have presented evidence that there is a great need for data management professionals, and that these are very skilled people usually hired many years after a degree program. Although, the DAMA body of knowledge points to information engineering skills, our survey evidence suggests that data management professionals have the skill set of an IS professional, in addition to the information engineering focus. Therefore, an augmented IS program plus years of maturation should produce a data management professional.

The DAMA Curriculum Framework points to a few DM programs. On close inspection sev-

eral of these programs are certificate programs, and several others are being phased out. For whatever reason, pure data management undergraduate degree programs seem to be unsuccessful.

Yet, the nation needs data management professionals. Currently, there are more than a thousand successful information systems programs. We argue that by augmenting the IS2002 curriculum specification as recommended below there will be stronger IS programs, and a viable path will have been established for developing data management professionals, perhaps through facilitated professional development: Conference speakers will make the case through excellence in personal and professional leadership. Young professionals will sort themselves out.

### **8. RECOMMENDATIONS:**

1. Data quality, data architecture, and metadata should be integrated in the IS2002 learning units. These are skills that must be part of the tool-set of any information systems professional. It may require an additional course to cover the concepts of data quality.
2. A course in data warehousing concepts should be added. Practical tools such as ETL and reporting tools should be practiced and become true skills. Warehouse design can be covered minimally. If an institution has an established decision support systems (DSS) course, this course could be expanded to include the concepts and techniques of data warehousing. However, the practical focus must be maintained.
3. A course in data mining concepts with limited practicum should be offered. Concepts of business intelligence can be integrated into this course. Reporting tools should be practiced. Inference tools can be included. Statistical tools can be included. Alternatively, an existing DSS course could be enhanced to include the concepts and limited practicum for data mining
4. A set of specifications could be defined for a specialist addendum to the ISA cer-

- tificate, e.g., the ISA-DM, and "Information Systems Analyst – specialty in Data Management.
5. The Information Systems Curriculum Task Force should include a representative from the Data Management Association.
  6. Data Management should be promoted to students so they see the vast potential job opportunities as their career advances.

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**Appendix of Figures**

Figure 1. Characteristics of Data Management Personnel. The data in the three panels are survey results from 1000 attendees to the DAMA International conference (Perez 2006).

(The figures are reproduced with permission of DAMA International.)

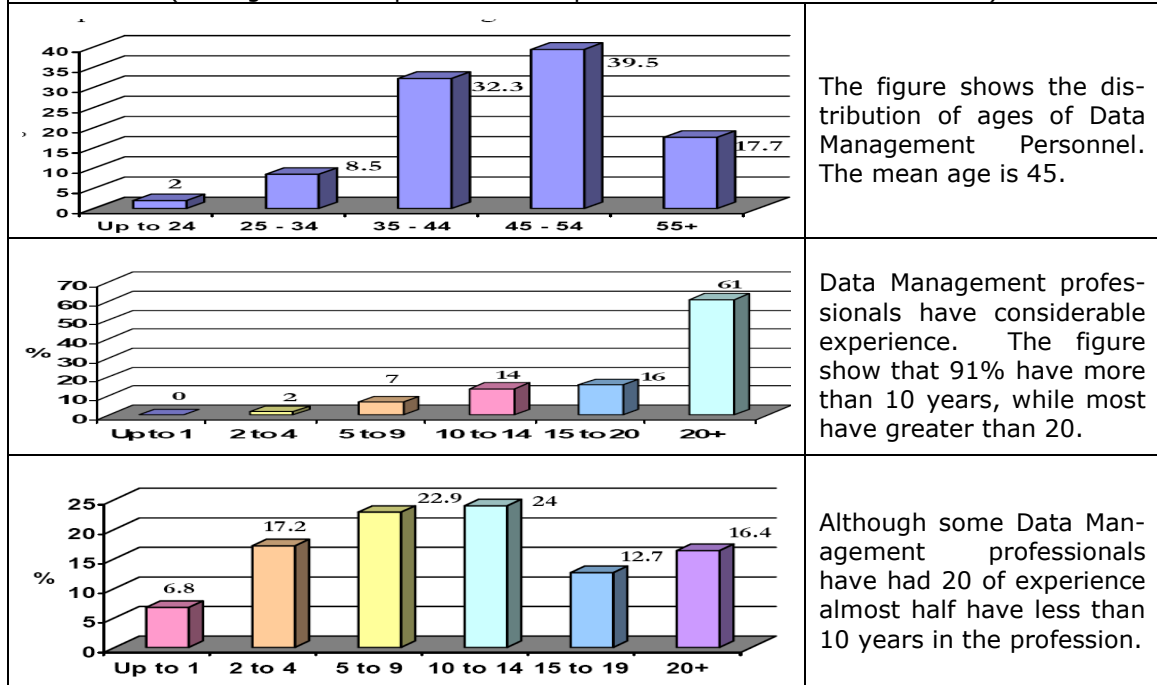


Figure 2. Comparison of Computing Professionals Expected Skill Depths for 49 Skills. Skill depth expectations are mean responses of the survey group, and are plotted in descending order of expectation for Database Analysts. (data from Haigood 2000).

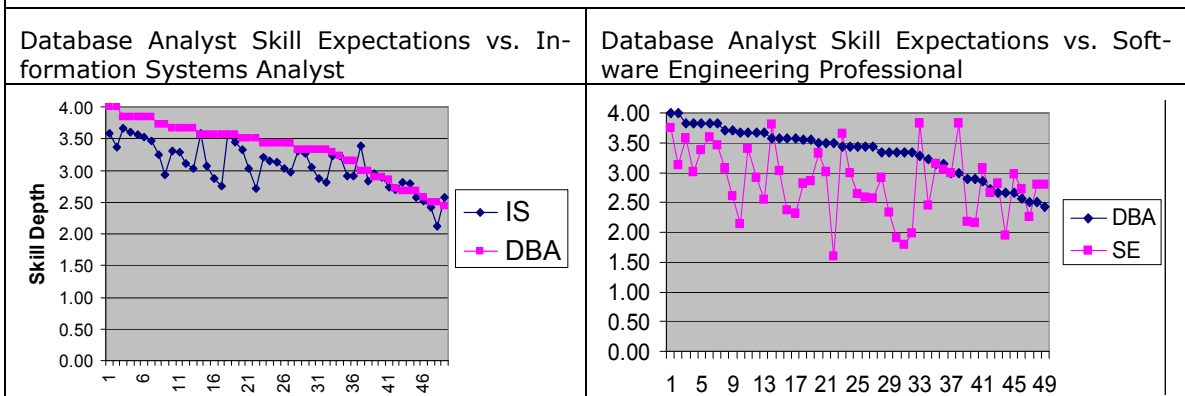


Figure 3. Skills Comparison between IS Analyst and Database Analyst (top 20 skills)

Question #	Question Description	IS	DBA
38	PERS-commit/completing	3.59	4.00
34	PERS-interpersonal skill	3.36	4.00
32	PERS-communication	3.66	3.83
39	PERS-customer focus	3.61	3.83
33	PERS-personal skill	3.56	3.83
35	PERS-learning to learn	3.53	3.83
37	PERS-self direction	3.46	3.83
11	DB-db development	3.24	3.71
12	DB-modeling	2.93	3.71
3	SAD-business problems	3.30	3.67
43	PERS-design	3.29	3.67
40	PERS-accountability	3.11	3.67
48	IS.MGT-project tracking	3.03	3.67
15	SD-problem solving	3.59	3.57
21	SD-sys documentation	3.06	3.57
31	TEAM-continuous imprv	2.88	3.57
13	DB-administration	2.75	3.57
4	SAD-computer & IS	3.56	3.56
10	SAD-analysis/design	3.44	3.56
36	PERS-Ethics	3.33	3.50
44	PERS-methodology	3.03	3.50
47	IS.MGT-IS function	2.72	3.50

Figure 4. Abstraction of the DAMA Framework Body of Knowledge.

The data is and abstraction from Henderson et al, 2004. We suggest the abstraction be called "Information Engineering".

**"Information Engineering": Data Life Cycle Management**

- Data Requirements Analysis and Documentation
- Data Modeling, Access and Security
  - Planning for Data & Metadata
  - Data Quality
  - Data Models and Modeling
  - Relational Data Model
  - Data Warehousing
  - Data Security
- Physical Database Access and Management
  - Data Storage Management
  - Data Access and Database Programming
  - Database failures, backup and recovery procedures
- Standards Creation, enforcement, maintenance

Figure 5. Life-cycle Relationships between Systems Engineering, Information Engineering, Software Engineering, and Business Process Development. A preliminary presentation of this figure was shared at (Longenecker 2006). The figure was initially presented in the work of (Yarbrough 2005).

CMMI	1.4.1	1.4.2			1.4.3		1.4.4		1.4.5		1.4.6			
Technical	System	Systems Analysis and Design			System Component Design		System Implementation		System Integration, Test and Evaluation		System Operation and Support		System Evaluation	System Maintenance
<b>Systems Engineering</b> <b>INCOSE</b>	System Feasibility	System Reqmts Analysis	System Design Interface	Verification, Validation and Certification Test Plan	Verification with customer reqmts	Verification of detailed design	Module validation with customer review	Application Validation with customer review and	System Reqmts Validation	Final System Evaluation	System Acceptance and operation validation	Initial Operation; Post Implementation Cleanup Certification	System Performance Review	Evaluation of Customer Satisfaction and CSF Attainment
<b>Information Engineering</b> <b>DAMA</b>	Data Information Governance and Stewardship	Information Reqmts	Data Base and Warehouse Architecture	Data Reqmts Analysis	Database Table & Stored Procedure Identification	Detailed Design Database Scripts; DQ Planning	Stored Procedure & Trigger Construction & Testing	Conversion & Planning and Construction	Conversion Testing	Data Evaluation	Database Deployment; Data Conversion Configure	Database Admin; Backup and Recovery	Capacity Performance & Quality Review	Database Admin; Access Mgt Backup
<b>Software Engineering</b> <b>SEI</b>		Software Systems Analysis	Software Systems Design	Software Reqmts Analysis	Software Module (Page Reports)	Detailed Software Layout (Screens and Reports)	Software Construction & Module Testing	Software Integration Testing	System Integration	Software Evaluation and Certification	Software Installation and Testing	Software Maintenance	End Software performance analysis	Use Maintenance and Updates
<b>Business Process</b>	Customer Reqmts Analysis	Business Goals and Objectives	Business Policy	Stakeholder Analysis	Work Flow Procedure Writing	Job Design	Procedure Manual Construction	Business Conversion Planning	Business Process System Support Evaluation	Final Acceptance Review	Job Training	Business Cutover and Initial Operation	Customer Satisfaction and Business Objectives Review	Customer Satisfaction And Business Process Efficiency

Figure 6. IS2002 Skill Set With Proposed Additions.

Sub-Skills 1.3.1,2,3 Were Defined in 2002.

Sub-Skills 1.3.4,5,6 Are Recommended Additions Based on the DAMA Framework.

Skill	Description	Job Ad Words
1.3.1	Modeling and design, construction, schema tools, DB Systems	modeling, SQL, construction, tools -top down, bottom up designs; schema, development tools; desk-top/enterprise conversions; systems: Access, SQLServer/Oracle/Sybase, data warehousing & mining; scripts, GUI tools
1.3.2	Triggers, Stored Procedures, Audit Controls: Design/Development	triggers, audit controls-stored procedures, trigger concepts, design, development, testing; audit control concepts/standards, audit control implementation, T-SQL, PL/SQL
1.3.3	Administration: security, safety, backup, repairs, replicating	monitoring, safety -security, administration, replication, monitoring, repair, upgrades, backups, mirroring, security, privacy, legal standards, HIPAA
1.3.4	Metadata: architectures, systems, and administration	definition, principles, practices, role of metadata in database design, repository, dictionaries, creation, ETL, administration, usage, tools
1.3.5	Data Warehouse: design, conversions, reporting	star schema, ETL, data cleansing and storage, reporting tools, business intelligence, analytic queries, SQL OLAP extensions, data mining
1.3.6	Data Quality: dimensions, assessment, improvement	Data Accuracy, Believability, Relevancy, Resolution, Completeness, Consistency, Timeliness; Data definition quality characteristics, Data model / requirements quality characteristics; Data clean-up of legacy data, Mapping, transforming, cleansing legacy data; Data defect prevention, Data quality employee motivation, Information quality maturity assessment, Gap analysis, data governance and stewardship