Master of Science Degree in Information Quality at the University of Arkansas at Little Rock*

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Abstract: *The Master of Science in Information Quality (IQ) program at the University of Arkansas at Little Roc is the first university-based program to offer a graduate degree information quality. The program was designed to prepare students for careers in industry and government as well as advanced graduate studies. The curriculum was inspired by the Model Curriculum and Guidelines for Graduate Degree Programs in Information Systems endorsed by the Association for Computing Machinery and Association for Information Systems. Now that the program has been in place for one year, this paper discusses a brief history of the program, the current curriculum structure, results from the first year, and future plans.*

1. Introduction

The field of information quality (IQ) has matured significantly over the last two decades. Much of the focus in early academic research and in the current data quality industry is on the Total Data Quality Management (TDQM) cycle (Madnick and Wang, 1992; Wang et al., 1995) or the Deming Cycle for data (Deming, 1986; Shewhart, 1931). In the rapidly changing global economy with fast-growing volumes of structured and unstructured data being created, stored, and mined for business intelligence, developing capabilities that will deliver relevant and meaningful information from both internal and external data available to an organization is a vital issue facing information providers and users with perspectives ranging from a single application to an entire enterprise or even a nation (Kaomea, 2005).

Unlike other disciplinary areas such as computer science, accounting, and finance, an academic program that provides a rigorous education to those interested in pursuing a career in the information quality field did not exist when the UALR MSIQ program was conceived in the fall of 2005. The UALR MSIQ was designed and implemented to meet the increasing demand for highly qualified IQ professionals by establishing a graduate-level program with a well-designed curriculum to provide comprehensive, systematic, and high-quality education on IQ.

2. The Genesis of the Program

The formation of the UALR MSIQ program was made possible by three key contributions

- The generosity of the MIT IQ and TDQM Programs and Dr. Richard Wang to share the body-of-knowledge in information quality developed through the International Conference on Information Quality and Executive Training Program,
- The willingness of Acxiom Corporation, its Company Leader, Charles Morgan, and Senior Business Development Leader, Jerry Adams, to underwrite the initial development of the program,
- The vision of the University of Arkansas at Little Rock and Dr. Mary Good, Dean of the Donaghey College of Engineering and Information Technology, to support the development and approval and to host such a novel and untried inter-disciplinary academic program.

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Thanks in large part to the *International Conference on Information* Quality (ICIQ), a body of IQ knowledge has been accumulated (Ballou et al., 1998; Lee, 2004; Madnick et al., 2004; Madnick and Zhu; Pierce, 2005; Talburt et al., 2004; Talburt et al., 2005; Wand and Wang, 1996; Wang and Strong, 1996; Wang et al., 1998). This conference, held annually at MIT over the past decade, has established a premier forum for IQ researchers and practitioners. The conference grew along with, and because of, participants from no less than thirteen international communities. Naumann et al. (2005) observes that over the years the ICIQ conference has spawned *SIGMOD workshops on Information Quality in Information Systems* and the *CAiSE Workshop on Data and Information Quality*. Germany in particular has built a large community, the *German Society for Information and Data Quality,* which organizes regular conferences and workshops. In addition, DAMA-I (Data Management Association International) and IAIDQ (International Association for Data and Information Quality) have industry conferences, seminars, and workshops on IQ topics. IQ practitioners have also established a Data Quality College, IQ Curriculum, and IQ certification.

Over the past decade, the Total Data Quality Management (TDQM) program and the Information Quality program at MIT have been offering four courses on IQ to information technology professionals and executives:

- IQ-1: IQ Principles and Foundations;
- IQ-2: Advanced IQ Theories;
- IQ-E: IQ for Executives; and
- IQ-C: IQ Case Studies.

While each of these courses covers a broad range of IQ topics, they are designed with different emphases on these topics. Loosely speaking, IQ-1 focuses on IQ technical skills, IQ-2 focuses on adaptive skills, IQ-E focuses interpretative skills, and IQ-C gives the students the opportunity to apply their comprehensive skills to analyzing real world problems. Our experience of teaching these courses indicates that a curriculum with a deeper and more systematic coverage on these diverse IQ skills is needed to equip students with sufficient capabilities for addressing today's wide range of IQ challenges.

During the past few years, Fisher (2001) has offered an IQ course for college seniors majoring in IS with a great success. The course covers the topics similar to those in IQ-1 and IQ-2 at introductory and intermediate levels. This is the first IQ course offered to college undergraduates in the United States. Positive feedback from students, their interests to learn more about IQ topics, and their success in their IQ related careers confirm the need for a more comprehensive curriculum for IQ.

Certain IQ product vendors and industry leaders have proactively responded to the critical demand for professionals with IQ skills. For example, FirstLogic has developed an IQ curriculum and offers courses at conferences or in the form of online seminars. While such course offerings bring valuable industry perspective to IQ education, they are often ad-hoc and sometimes biased towards a particular vendor technology or approach. An IQ curriculum at universities can avoid such shortcomings.

As pointed out by Landry et al (2003), an effective IS curriculum should balance tradition with innovation. There has been an effort of developing and keeping up to date a coherent IS curriculum for more than 30 years (Gorgone et al., 2003). The most recent model curriculum is IS-2002 which is a useful reference for updating and improving existing IS undergraduate curricula (Dwyer and Knapp, 2004). In terms of IQ education however, this model curriculum shares the same weakness identified by Khalil et al (1999) as that of IS-1997 although IS-2002 does provide the prerequisite background knowledge for a master's curriculum in IQ.

3. Current MSIQ Curriculum

Much of the individual course content is developed based on cumulated research results and experiences developed over the last two decades. The curriculum is designed to balance information quality theory with industry best practices using state-of-the-art tools and technology. The current curriculum comprises 33 credit hours including 27 hours of course work and 6 hours of credit for either a master's thesis or a

graduate project. The program is accessible to both day and evening students on either a full-time or part-time basis. Most of the courses are offered in the evenings beginning after traditional working hours. Beginning with the fall 2007 semester, the courses for this program are scheduled to meet one evening per week, and the live, on-campus classroom lectures will be simultaneously "webcast" for students registered for remote access. In addition, the live lectures will be recorded for later viewing by both on-campus and remote students.

3.1 Program Objectives

The mission of the MSIQ program is to provide graduate instruction for the improvement of information quality to individuals from a wide range of backgrounds. In addition, the MSIQ program shall contribute to new knowledge in information quality research and curriculum development as well as forming partnerships to serve local, regional and national needs in this area.

Specific goals of the MSIQ program are as follows:

- To produce graduates who are well prepared to assume leadership roles in improving information quality.
- To develop state of the art curriculum in information quality education.
- To contribute new ideas to the information quality body of knowledge.
- To develop partnerships between the community, government, industry, and MSIQ participants for the purpose of improving information quality.

Upon completing the program, students are expected to possess adequate information quality knowledge and skills, which were identified through a review of the published research on information quality skill sets and from surveys of companies that employ data quality analysts. The expected learning outcomes are:

- Graduates must have a solid foundation in Information Systems Concepts and Database Applications
- Graduates must know the principles of total quality management and statistical process control.
- Graduates must possess the tools and knowledge for how to define, measure, manage, and improve information quality at all levels (operational, tactical, and strategic) of an organization.
- Graduates must be able to multitask and manage both their time and projects effectively.
- Graduates must demonstrate strong communication, interpersonal, leadership, and team skills
- Graduates must be able to think analytically and critically.

3.2 Admission Requirements

Students entering the program should have sufficient background that prepares them for the coursework and research projects required to complete the MSIQ degree. Below are the admission requirements for the program:

- Baccalaureate degree in information science, computer science, computer information systems, management information systems, statistics or a related discipline from an accredited institution.
- Cumulative grade point average of at least 3.0 on a 4.0 scale.
- Graduate Record Examination (GRE) general test section or Graduate Management Admission Test (GMAT) with acceptable scores.
- All students seeking regular admission to the program are expected to have completed (with a grade of B or better in each course) undergraduate coursework covering the following topics:
    - Object-Oriented Software Development
    - Database Concepts
    - Applied Statistics

3.3 Program Requirements

There are two options within the MSIQ degree program.

- Thirty-three (33) credit hours, consisting of 27 hours of course work and six hours of Project
- Thirty-three (33) credit hours, consisting of 27 hours of course work and six ours of Thesis

3.3.1 Core Requirements

All students must take the following seven courses (21 credit hours), grouped into two categories: Information Quality and Information Science.

Information Quality Courses:

- INFG 7303 Introduction to Information Quality
- INFQ 7318 Total Quality Management and Statistical Quality Control
- INFQ 7322 Information Quality Theory
- INFQ 7342 Information Quality Tools and Industry Landscape

Information Science Courses:

- IFSC 5345 Information Visualization
- IFSC 7310 Information Systems Analysis
- IFSC 7320 Database Systems

In addition to the core courses, students must select two electives (6 credit hours), one each from the two categories listed below.

One elective course must be chosen from the following list:

- INFQ 7337 Project and Change Management
- INFQ 7353 Case Studies for Information Quality Professionals
- INFQ 7367 Information Quality Policy and Strategy

One elective course must be chosen from the following list:

- IFSC 5325 Data Mining Concepts & Techniques
- IFSC 5330 Database Security
- IFSC 7325 Advanced Data Mining
- IFSC 7360 Data Protection and Privacy
- MGMT 7308 Advanced Business Communication
- MGMT 7312 Team Development

3.3.2 Substitution of Core Requirements

An Information Quality Graduate Committee needs to be set up to evaluate student requests for substituting core courses of the curriculum. Substitution is allowed if in the committee's opinion an entering student has already completed the same level of work prescribed for that core course or courses through previous academic work or professional experience.

3.3.3 Graduation Requirements

To graduate from the program, a student must satisfy two requirements:

- Cumulative GPA of at least 3.0 in the approved program of study as outlined above
- Successful completion of one of the program options

4. Rationale for the curriculum

The curriculum for the Masters of Science in Information Quality is patterned after the Model Curriculum and Guidelines for Graduate Degree Programs in Information Systems (MSIS 2000) endorsed by the Association for Computing Machinery and Association for Information Systems (Gorgone et al., 2000). Designed to be compatible with the degree structures of the United States and Canada's educational systems, the MSIS 2000 model provides resource guidance to institutions, curriculum direction to faculties, and a better understanding of the discipline for students and employers. MSIS 2000 is designed around a set of five building blocks as shown in Table 1 which are meant to ensure that students master a common body of knowledge while allowing students the opportunity to specialize in a specific subject area.

Table 1: Comparison of MSIS 2000 and MSIQ Curriculum

MSIS 2000 Curriculum Building Blocks	Master of Science in Information Quality
IS Foundation: Prescribes a minimum level of prerequisite IS knowledge. • Fundamentals of IS • IT Hardware and Software • Programming, Data and Object Structures	Students will meet this criterion through the admission requirements for the program. It is anticipated that the majority of students entering this program will possess either a degree related to information technology or have work experience in this area.
Business Foundation: Prescribes a minimum level of basic business knowledge. • Financial Accounting • Marketing • Organizational Behavior	Students will meet this criterion either through other academic work or through work experience. It is anticipated that the majority of students entering this program will be working professionals familiar with a variety of business functional areas and processes.
IS Core: Defines the minimal knowledge required of all MSIS students. • Data Management • Analysis, modeling, and design • Data Communications and networking • Project and change management • IS Policy and Strategy	MSIQ students will complete the following information science/quality coursework. • IFSC 7320: Database Systems • IFSC 7310 Information Systems Analysis • One course from the following list: IFSC 5330 Database Security, IFSC 7325 Data Mining, or IFSC 7360 Data Protection and Privacy. • One course from the following list: INFQ 7337 Project and Change Management, INFQ 7353 Case Studies for IQ Professionals, or INFQ 7367 IQ Policy and Strategy. • IFSC 5345 Information Visualization.
Integration: A course that allows students to synthesize what they have learned from either the perspective of integrating the Enterprise, the IS function or IS technologies.	MSIQ students must complete either INFQ 7686 Graduate Project or INFQ 7698 Thesis. Both of these courses are designed to help students synthesize, integrate, and apply what they have learned.
Career Tracks: A set of courses organized around a particular IS career.	MSIQ students will complete the following courses designed to prepare individuals for a career in Information Quality. • INFQ 7303: Introduction to Information Quality • INFQ 7318: Total Quality Management and Statistical Quality Control • INFQ 7322: Information Quality Theory • INFQ 7342: Information Quality Tools and Industry Landscape

In comparing the MSIQ curriculum with the MSIS 2000 curriculum model, one sees that the biggest divergence occurs in the IS core. The core courses for the MSIQ were selected to cover those IS areas most needed by IQ professionals. For IQ professionals, a thorough knowledge of data management and systems analysis is crucial so these courses map very closely to their MSIS 2000 counterparts. Because an IQ professional's main focus is on data, the MSIS 2000 data communications and networking specification was replaced with IS coursework that emphasizes the security and use of data within an organization. Because it is likely that the majority of students in this program will be working IS professionals, it is anticipated that many students will have some previous experience in IS project management or policy setting. Thus electives were constructed in these areas to give students the ability to select the subject matter of most benefit to them. In addition, students who have sufficient experience in either an IS or IQ core requirement may substitute with permission of the IQ Graduate Committee up to six hours of other relevant graduate-level courses. The last course in this list, information visualization, does not have a counterpart in the MSIS 2000 IS core; however, because it deals with the design and presentation of digital information, it represents an IS topic that all IQ professionals should know.

5. Results from the First Academic Year (2006-2007)

The UALR MSIQ program admitted its first students in the fall 2006 semester with a total enrollment of 25 students. All but one of the students in the first class were working professionals. The initial cohort of students for the program came from a variety of backgrounds including:

- 15 students with degrees in Information Science, Computer Science or Engineering
- 5 students with business degrees
- 5 students with other degrees in other areas including English, Legal Studies, History, Anthropology, and Biology
- 5 students had already earned another master's degree

Most students in the program enrolled in 2 classes (6 hours) per semester during the fall and spring semesters, and 13 students enrolled for one class in the 2007 summer semester. Three students left the program during or at the end of the fall 2006 semester, but two new students started the program in the spring 2007 semester.

The courses offered in the program during the fall 2006 semester were

- INFQ 7303, Introduction to IQ (24 students)
- INFQ 7318, TQM & Statistical Quality Control (21 students)
- IFSC 5325, Data Mining (1 student)
- IFSC 5345, Information Visualization (3 students)

The courses offered in the program during the spring 2007 semester were

- INFQ 7342, IQ Tools & Industry Landscape (15 students)
- INFQ 7322, IQ Theory (8 students)
- IFSC 7310, Information Systems Analysis (18 student)
- IFSC 7320, Database Systems (11 students)

The courses offered in the program during the summer 2007 semesters were

- INFQ 7367, IQ Policy & Strategy (12 students)
- INFQ 7386, Project (3 students)

One student has applied or graduation at the end of the summer 2007 semester (August 2007) demonstrating that the degree can be earned in 12 months by a full-time student. Another 3 to 5 students are on track to be graduated at the end of the fall 2007 semester (December 2007). The majority of the initial cohort will likely be graduated by the end of the spring 2008 semester (May 2008) thus confirming that the expected time for program completion is 12 to 24 months for students taking 12 to 6 hours of coursework per semester, respectively.

The accommodation of the distance education in the second year of the program has helped to bring in additional students. Although the final numbers for the second cohort will not be complete until August of 2007, there are already of number of applications from new students. At this writing, 18 new students have already been granted regular or conditional admission to the program, and applications from 13 additional applicants are under review awaiting transcripts, test scores, and other information.

Because of the hybrid on-campus/online delivery of lectures planned for the fall 2007 course offerings, the distinction between on-campus and online students has been blurred. Students in these courses may elect for any given course module to participate in the classroom, online with the live webcast, or online using previously recorded lectures. A more useful classification is local versus remote students where local indicates that the student is within reasonable commuting distance of the Little Rock campus. Early indications are that approximately 1/3 of the second year cohort will be remote with home locations such as Illinois, North Carolina, and Wisconsin in the US, and Brazil and South Africa overseas.

6. Prospects for Placement of MSIQ Graduates

Although many of the current students are fully employed, the ultimate test of the program will be in the successful placement of graduates in information quality roles. The placement of graduates for the MSIQ program should not be a problem given that within the private sector, data quality initiatives are on the rise. Gartner, Inc. estimates that investments in data quality suites are growing at a rate between 12 and 15% annually (Gilhooly, 2005). Companies are increasingly concerned about poor data quality because it inhibits the success of customer relationship management, enterprise resource planning, and data warehousing initiatives as well as contributing to compliance violations and supply chain inefficiencies.

Within the public sector, two federal mandates have provided impetus for information quality. The Data Quality Act of 2001 (Section 515 of Public Law 106-554) requires the Office of Management and Budget to promulgate guidance to agencies ensuring the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by federal agencies. Similarly, the Sarbanes-Oxley Act of 2002 places stringent auditing and reporting requirements on certain categories of information maintained by companies.

As a result of these changes, there is a growing job market for trained professionals who understand the concepts, principles, tools, models, and techniques that are essential for information quality definition, measurement, analysis, and improvement, and who can guide organizations in setting information quality policies and strategies. A January 2006 search of www.dice.com, a job search engine for IT professionals, reveals numerous postings for traditional IT jobs like consultant, database/programmer analyst, data/systems analyst, ETL developer, and database architect that include data quality activities as part of the job description. In addition, there are now jobs devoted entirely to information quality improvement. Titles like Data Cleansing Quality Analyst, Data Quality and Integrity Consultant, Data Quality Analyst, Data Quality Assurance Analyst, Data Quality Project Manager, and Senior Data Quality Architect are just a few of the positions available to individuals interested in this emerging career area. Employers represent a multitude of industries ranging from healthcare, manufacturing, financial services, retail, federal government, and IT consulting services.

In addition to becoming IQ professionals who monitor, improve, and manage IQ at various organizations, the graduates are also well prepared to pursue Doctorates with a focus on developing IQ theories and techniques. Their work in practice and research will advance the field of IQ.

7. Future Plans

Assessment is an important component of any academic program. Feedback from MSIQ students, employers, and alumni will be collected and assessed so that the curriculum can be further improved to meet industry and government's need for better information quality, and to ensure that this program will serve as a benchmark to other academic institutions interested in offering IS degrees specializing in data and information quality.

In addition, the University of Arkansas at Little Rock has already submitted a proposal to open a new Applied Information Quality track within its existing PhD in Applied Science program. If approved, this would provide a program for students interested in pursuing doctoral-level studies in information quality. Several students currently in the MSIQ program have expressed an interest continuing into doctoral studies as have a number of interested individuals working in advanced information quality roles in industry and government. Producing PhD-credentialed information quality professionals will be of growing importance as other schools seek faculty to support their own graduate and undergraduate programs in information and data quality.

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