A Curriculum for a Master of Science in Information Quality

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ABSTRACT

The first Master of Science in Information Quality (MQ) degree is designed and being offered to prepare students for careers in industry and government as well as advanced graduate studies. The curriculum is guided by the Model Curriculum and Guidelines for Graduate Degree Programs in Information Systems, which are endorsed by the Association for Computing Machinery and the Association for Information Systems. The curriculum integrates two key educational innovations: (1) an interdisciplinarily approach to curriculum design, and (2) a balance between theoretical rigor and practical relevance. In response to the demand from industry, the curriculum aims to educate students who can lead the effort to solve current and future information quality problems. As such, problem-based learning is balanced with foundation-building learning to effectively deliver the intellectual contents of the curriculum. Much of the individual course content is based on cumulative research results and practices developed over the last two decades. The curriculum is designed to balance information quality theory with industry best practices using modern tools and technology. It includes the skill sets that are critical to succeed as IQ professionals. Since IQ is an inter-disciplinary field, the curriculum draws upon total quality management, database, core knowledge of IQ, change management, project management, and IQ policy and strategy. The courses are delivered using case studies, hands-on laboratories, theory building, and team projects to enhance the student’s learning experience. Upon completing the program, students will be equipped with sufficient breadth and depth in the IQ field to solve real world problems and pursue further studies.
1. INTRODUCTION

The field of information quality (IQ) has matured significantly over the last two decades. Much of the focus of early academic research and the current data quality industry is on utilizing the Total Data Quality Management cycle (Madnick and Wang, 1992; Wang et al., 1993) or the Doning Cycle (Deming, 1986; Shewhart, 1931) for improving data quality. In the rapidly changing global economy with fast-growing volumes of structured and unstructured data being created, stored, mined, and used for business, 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. Increasingly, leading organizations are raising questions such as:

- How do we leverage information quality strategically to achieve and sustain competitive advantage in our business?
- "I have heard complaints about information quality in our organization. How do I systematically measure and improve information quality?"
- "What tools are available and useful for information quality management?"
- "Are there any general theories and rigorous methodology that I can apply to solving problems in my organization?"
- "Where can I learn about success or failure stories of other organizations in their information quality management?"
- "Where can I send my staff for formal systems education on information quality?"

Unlike other disciplinary areas such as computer science, accounting, or finance, an academic program that provides a rigorous education to those interested in pursuing a career in the information quality field did not exist until 2006. Although various academic and industry firms exist, their programs often to share new developments in IQ research and practice. To meet the increasing demand for high-quality IQ professionals, it is important to establish a graduate-level program with a well-designed curriculum to provide comprehensive, systematic, and high-quality education on IQ. Graduates from this program will become the leaders and problem solvers in organizations facing IQ problems. They will also be equipped with the knowledge and skills to pursue advanced studies in the IQ field.

The development of a rigorous and practical curriculum for a Master of Science in Information Quality (MSIQ) is a pioneering and challenging undertaking. As there has been no prior effort in developing such a curriculum, one can only draw upon previous work that addresses certain aspects of IQ education. In this paper, we present an effort to offer the first MSIQ degree. Section 2 describes previous efforts to incorporate information quality topics into the Information Science curriculum. Section 3 presents the guiding philosophical discussions on the program's pedagogy.
relative importance of these skills differently. The implication is that both short-term and long-term separations of the students need to be considered in designing IQ curricula because graduates from an IQ program will take on these various roles at different stages of their career.

Over the past decade, the Information Quality program at MIT has 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
- 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. IQ-1 focuses on IQ technical skills, IQ-2 focuses on adaptive skills, IQ-E focuses on interpreting skills, and IQ-C gives the students the opportunity to apply their comprehensive skills to analyzing real world problems. Our experience with teaching these courses indicates that only a curriculum with a deeper and more systematic coverage on these diverse IQ skills can equip students with sufficient capabilities for addressing various challenges.

During the past few years, Marist College (Fisher, 2001) has offered an IQ course for college seniors majoring in IS with great success. This is the first IQ course offered to college undergraduates in the United States and it covers topics similar to those in IQ-1 and IQ-2 at the introductory and intermediate levels. Positive feedback from students, their interest to learn more about IQ topics, and their success in their IQ related careers confirm the need for a more comprehensive IQ curriculum. Beginning in 2007, Northeastern University plans to offer its first Information Quality course for undergraduate honors students, as well as a short elective course in information quality for MBA students. Nonetheless individual courses offered in a formal university setting cannot cover the depth and breadth of the skills and knowledge that an IQ degree program can offer.

Certain IQ product vendors and industry leaders have argued that this reflects the critical demand for professionals with IQ skills. Examples include "Data Quality University" by NaviMine Consulting, "90 IQ Curriculum" by FirstStep IQ Education, and "Information Impact. Other renowned practitioners are designing and delivering IQ focused courses in the U.S. and internationally. While such offerings bring valuable industry perspectives to IQ education, they are often ad-hoc and sometimes based towards a particular vendor technology or consulting approach. An IQ curriculum offered at universities can avoid such short-comings.

Lemple et al. (2003) indicate that 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 (Lemple et al., 2003, The Joint Task Force for Computing Curricula 2005, 2005). 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 of IS-1997 identified by Lemple et al. (1999) with the exception that IS-2002 does provide the prerequisite background knowledge for a Master's curriculum in IQ. The curriculum that we present in this paper rectifies this weakness by focusing on innovations in IQ management that have emerged over the past two decades.

Next we discuss the philosophical underpinnings of the objectives of the program and the curriculum.

3. PHILOSOPHICAL APPROACHES TO PEBAGOOGY

The MISIQ program bases its education on two complementary philosophical approaches in learning: problem-based learning (Baker, 1999) and foundation-building learning. Following the movement of professional educational programs (such as medical education) toward problem-based learning, the MISIQ Program exploits the practice-oriented problem-based learning, which facilitates learning by exposing students to the comprehensive context of the problem. As observed in Lee (2004), context - reflective problem solving is based on inter-disciplinary problem-solving techniques and approaches, and thus, supports the aim of the MISIQ Program. This approach is also in line with the much earlier inquiry by the influential scholar John Dewey (Dewey, 1933; 1938) on learning and education that emphasizes experience, inquiry, and reflection. Foundation-building education is equally important to the MISIQ program because it prepares students with theoretical rigor that will go a long way in their career.

For each course, a project, the MISIQ Program aims to promote both foundation-building learning and problem-based learning approaches instead of designing a specific course for one approach or the other. The curriculum is developed so that faculty can deliver a course in a way that maximally benefits from both approaches, with the understanding that some courses will focus more on one approach than the other based on the nature of the materials covered in the course. In terms of emphasis, case studies, projects, and thesis are designed in ways that benefit students from the perspective of problem-based learning, while other fundamental theory related contents benefit students from the perspective of foundation-building learning.

Another related philosophical approach to the MISIQ Program is the balance between theoretical rigor and practical relevance. The MISIQ Program is well-balanced in area. First, most foundation-building courses covered in the MISIQ Program are based on applied research that uses data from the real world. Therefore, the theoretical courses have embedded rigor with relevance. Second, the curriculum expects the need to produce IQ professionals for a growing number of companies and government organizations that are seeking individuals who can solve current and future IQ problems. This demand from the job market for IQ graduates creates a healthy environment for the MISIQ Program as it continuously works to keep the curriculum useful, relevant, and up-to-date.

Exploiting the above main philosophical approaches, the MISIQ Program provides the fully developed IQ education that is needed. The next section provides the rationale and details of the curriculum designed to produce IQ professionals who can solve IQ problems over the different stages of their careers.

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4. THE CURRICULUM: RATIONALE AND STRUCTURE

4.1 Rationale for the Curriculum

The MSIS Program is patterned after MSIS 2000, the Model Curriculum and Guidelines for Graduate Degree Programs in Information Systems, which are endorsed by the Association for Computing Machinery and the Association for Information Systems (Goriupse et al., 2000). Designed to be compatible with the degree structures of the United States and Canada’s education systems, the MSIS 2000 model provides guidance to institutions, a 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 the left half of 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.

Following the MSIS 2000 guidance, the MSIS curriculum also has five building blocks. A comparison of two curriculums is summarized in Table 1. The University of Arizona at Little Rock (UALR) Model has implemented the MSIS curriculum. The course numbers of UALR are used in the comparison. Detailed descriptions of the courses can be found in the Appendix. In comparing the MSIS Program with the MSIS 2000 curriculum model, one sees that the biggest divergence occurs in the IS core. The core courses for the MSIS Program were selected to cover those IS areas most needed by IS professionals. The MSIS Program requires fundamental IS courses, such as Information Systems Analysis (Harris et al., 2006) and Database Systems. For IS professionals, a thorough knowledge of data management and systems analysis is crucial so these courses may vary closely to their MSIS 2000 counterparts. Because an IS 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 both MSIS Programs will be seeking IS professionals, it is anticipated that many students will have some previous experience in either IS project management or IS strategic planning. Thus, electives were constructed in these areas to give students the ability to select the subject matter of most benefit to them. The last

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<tr>
<th>MSIS 2000 Curriculum Building Blocks</th>
<th>Master's Science in Information Quality</th>
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<tbody>
<tr>
<td>IS Foundation: Prescribes a minimum level of prerequisite IS knowledge.</td>
<td>Students will meet this criterion through the admission requirements for the MSIS Program. It is anticipated that the majority of students entering the MSIS Program will possess either a degree related to information technology or have work experience in this area.</td>
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<tr>
<td>• Fundamentals of IS</td>
<td></td>
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<td>• Hardware and Software</td>
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<td>• Programming, Data and Object Structures</td>
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<tr>
<td>Business Foundation: Prescribes a minimum level of basic business knowledge.</td>
<td>Students will meet this criterion either through other academic work or through work experience. It is anticipated that the majority of students entering this MSIS Program will be working professionals familiar with a variety of business functional areas and processes.</td>
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<tr>
<td>• Financial Accounting</td>
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<td>• Marketing</td>
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<td>• Organizational Behavior</td>
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<tr>
<td>IS Core: Defines the minimal knowledge required of all MSIS students.</td>
<td>MSIS students will complete the following information science/equality coursework.</td>
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<tr>
<td>• Data Management</td>
<td>• IFSC 7320 Database Systems</td>
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<td>• Analysis, modeling, and design</td>
<td>• IFSC 7316 Information Systems Analysis</td>
</tr>
<tr>
<td>• Data Communications and Networking</td>
<td>• One course from the following list: IFSC 7325: Data Mining Concepts and Techniques, IFSC 7330: Database Security, IFSC 7325: Advanced Data Mining, or IFSC 7350: Data Protection and Privacy</td>
</tr>
<tr>
<td>• Project and change management</td>
<td>• One course from the following list: INFO 7337 Project and Change Management, INFO 7333 Case Studies for IS Professionals, or INFO 7367 IS Policy and Strategy</td>
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<tr>
<td>• IS Policy and Strategy</td>
<td>• IFSC 7345 Information Visualization</td>
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<td>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.</td>
<td>MSIS students must complete either INFO 7648 Graduate Project or INFO 7698 Thesis. Both of these courses are designed to help students synthesize, integrate, and apply what they have learned.</td>
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<tr>
<td>Career Tracks: A set of courses organized around a particular IS career.</td>
<td>MSIS students will complete the following courses designed to prepare individuals for a career in Information Quality.</td>
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<tr>
<td></td>
<td>• INQ 7303: Introduction to Information Quality</td>
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<td></td>
<td>• INQ 7318: Total Quality Management and Statistical Quality Control</td>
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<td>• INFO 7322: Information Quality Theory</td>
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<td></td>
<td>• INFO 7474: Information Quality Tools and Industry Landscape</td>
</tr>
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Table 1: Comparison of MSIS 2000 and MSIS Program

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Table 2: MSIQ Program Degree Plan

5. PLACEMENT OF MSIQ GRADUATES

Within the private sector, data quality initiatives are on the rise. Garrett Group 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 106-354) requires the Office of Management and Budget to promulgate guidance to agencies ensuring the quality, objectivity, activity, 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. The area of data quality is advancing far beyond the initial definition and measurement of data quality. A deeper and more comprehensive set of knowledge is needed for broader and deeper analysis of data quality problems that includes developing strategies and policies, understanding Information Product maps, managing information as product, and applying more sophisticated methods to improving quality of data (Lee et al., 2006; Madnick et al., 2004; Madnick and Zhu, 2006; Patric, 2005; Talbert et al., 2004; Wang et al., 1998). A recent search of www.dice.com, a job search engine for Information Technology (IT) professionals, reveals numerous postings for traditional IT jobs such as consultant, database/programmer analyst, data/systems analyst, ETL developer, and database architect that include...
dat 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 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 Information Technology consulting services.

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

6. CONCLUSIONS

The University of Arkansas at Little Rock (UALR) began offering MSIQ courses in Fall 2016. Twenty-five students enrolled in the first semester of the MSIQ Program. The vast majority of MSIQ students are working professionals who are taking their MSIQ coursework on a part-time basis. These working professionals come from Little Rock's business community, high tech industry, education institutions, as well as state government. A few students enrolled in the MSIQ program directly from their undergraduate programs. As is true for any pioneering programs such as the first computer science, the first information science, or the first bio-engineering program, the creation of the MSIQ program at UALR encountered several difficulties, the primary of which was to justify the need for creating such a program. We resolved this difficulty via several means. We conducted surveys to estimate demand in the industry and to project the enrollment in the next few years. We also established strong relationships with the industry and other academic institutions to gain their support ranging from student scholarships, internship opportunities, software, and instructional materials.

In addition, the risk of the program will managed and minimized via periodic evaluations. Frequent feedbacks will be taken into account to adjust the materials for courses and approaches for pedagogy. Currently the UALR MSIQ program is in the process of developing a cooperative education experience into its curriculum so that interested students can obtain real world IQ experiences that can be applied towards the development of either a student’s thesis or industry project. Other changes such as the addition of special topics courses and independent courses as well as enhancing the delivery of courses using web based learning tools are also underway. The early feedback from students and individuals familiar with the program indicates that the MSIQ program is laying the groundwork to lead other institutions in fulfilling the need for educating graduate students for the advanced and applied area of information quality as industry and government continue their demand for IQ professionals. In our opinion, the UALR MSIQ program is presently negotiating with another university interested in developing its own graduate program in Information Quality.

It should be noted that there is also a strong interest and pent-up demand in the IQ community for a doctoral degree program in Information Quality. Several of the 35 students currently enrolled in the UALR MSIQ program already hold a master’s degree and a number of these students have said they would have enrolled in a doctoral program in IQ if it were available. In addition several other qualified individuals, not currently enrolled in the program, have also indicated their desire to enroll in a doctoral program if it were to be offered. As a result, UALR is now working through their applied science division on developing the first-of-its-kind Ph.D. degree in Information Quality. The MSIQ curriculum provides us with a foundation on which we can develop a Ph.D. curriculum, and the MSIQ program will be a convenient stepping stone.

7. ENDNOTES

1 Through this paper, we will use the terms data and information interchangeably without engaging in the debate of differentiating or not differentiating the two in the interest of the focus and the space available.

2 A credit hour roughly corresponds to one hour per week of lecture time. For example, a 3-credit hour course has 3 hours of lecture time per week.

3 In the U.S., students receive letter grades that correspond to numerical grades, often in the scale of 0-4. The cumulative grade point average is the weighted average of the grades of a student, with the weight being the credit hours of each course.

8. REFERENCES


the intersection of information quality and data integration, particularly the areas of entity resolution and entity identification. Prior to his appointment at UALR, he was a leader for research and development in information management at Axiaom Corporation. Professor Talburt is an author and a leader for numerous articles on information quality and entity resolution. He also serves as an Associate Editor for the newly created ACM Journal of Data and Information Quality.

Richard Y. Wang is Director of MIT Information Quality Program at the Massachusetts Institute of Technology. He also holds an appointment as a Visiting University Professor of Information Quality, University of Arkansas at Little Rock. Before joining the MIT IQ program, Dr. Wang served as a professor at MIT for a decade. He also served on the faculty of the University of Arizona, Tucson and Boston University. Wang has put the term Information Quality on the intellectual map with myriad publications. In 1996, Prof. Wang organized the premier International Conference on Information Quality, which he has served as the general conference chair and currently serves as Chairman of the Board. Wang’s books on information quality include Quality Information and Knowledge (Prentice Hall, 1999), Data Quality (Kluwer Academic, 2001), Introduction to Information Quality (MITIQ Publications, 2005), and Journey to Data Quality (MIT Press, 2006). Prof. Wang has been instrumental in the establishment of the Master of Science in Information Quality degree program at the University of Arkansas at Little Rock, the Stuart Madnick IQ Best Paper Award for the International Conference on Information Quality (the first award was made in 2005), and the Donald Bollay & Harry Fizer IQ Ph.D. Dissertation Award. Wang’s current research focuses on extending information quality to enterprise issues such as architecture, governance, and data sharing. Additionally, he heads a U.S. Federal project on Leadership in Enterprise Architecture Deployment (LEAD). Professor Wang is the recipient of the 2005 DAMA International Academic Achievement Award.

Hongwei Zhu is an Assistant Professor of Information Technology at the College of Business and Public Administration, Old Dominion University. He holds a Ph.D. in Technology, Management and Policy from MIT. His research interests include data integration and reuse technologies, data quality management, data mining, information policy analysis, and information economics.