

# A Systematic Approach to Evolving the Curriculum in a Graduate IT Program

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## Abstract

The high tech industry is undergoing an evolution, largely driven by recent trends toward IT commoditization and ubiquitous computing. Supporting these trends are advances in cloud-based services, big data technologies, service-oriented architecture, mobile computing, and other enabling technologies. Graduate programs in information technology/information systems (IT/IS) must also evolve to maintain their relevance and vitality. In this paper, a systematic approach to revising a Master of Science in IT (MSIT) program offered within a business school context is described. As part of this process, input was sought from industry stakeholders, alumni, faculty, and current students. Reviewing the curricula of competing programs was also recognized as an essential step in thoroughly assessing and advancing the curriculum. Recommendations resulting from the review process have already led to enhancements to the program as well as plans for future changes.

**Keywords:** Master's program in IT, program evaluation, curriculum recommendations, program outcomes, knowledge and skills

## 1. INTRODUCTION

IT professionals continue to be in high demand. The US News top pick for the best job was in the IT field for the first time in 2014, and three IT positions were in the top ten in both 2014 and 2015 (US News, 2015). The growth in mobile applications, the shift to cloud computing, advances in big data technologies, and the increased focus on computer infrastructure security are some of the factors behind this trend.

In making the case for the need to revise the Information Systems (IS) model curriculum defined in MSIS 2006 (Gorgone, Gray, Stohr, Valacich, & Wigand, 2006), Topi, Conboy, Donnellan, Ramesh, Van Toorn, and Wright (2014) note the rise in virtualization and cloud computing, the intertwining of data management and analytics, and the increased demand for Big Data/NoSQL technologies.

In spring 2014, faculty in the MSIT program at Bentley University began a yearlong review process, culminating with recommendations for program revisions. The primary motivation for this process was to ensure the teaching of core competencies while embracing the driving forces of the evolving digital economy. This paper focuses on the curriculum-related components of the review and the recommendations emanating from it.

While solid technical skills are needed to be competitive in today's IT job market, strong management, communication, and interpersonal skills are just as essential (see, for example, Legier, Woodward, & Martin, 2013; Van Auken, Chrysler, Wells, & Simkin, 2011). Managing the balance between technical and managerial content is critically important for successful graduate programs in IT/IS. Striking the right balance was also a motivating factor in the curriculum revision process.

Students graduating from the MSIT program embark on careers as consultants, analysts (e.g., business, risk, systems), project managers, systems architects, and so on, in a wide variety of industries. Our curriculum needs to prepare graduates for those initial positions while also developing the skills and business acumen required for advancing rapidly in both technical and managerial careers. Gathering input from hiring managers, alumni, and graduating students was therefore recognized as a key requirement for the review process.

In the following pages, we first review related work. The curriculum at the start of the review process is then presented. Next, we provide a detailed description of the primary components of the review. Recommended revisions to the program, including changes that have already been implemented, are then presented. This is followed by concluding remarks on the review process.

## 2. RELATED WORK

The emphasis on assessment by educational accreditors has led to growing interest in assessment models and practices. Al-Mubaid, Kim, Yue, Hall, and Abeysekera (2010) present a conceptual assessment model for computing and IS programs that consists of a guidance component ("where to go"), an evaluation component ("where we are"), and a feedback component for quality assurance. Lessons learned from implementing their approach included the efficacy of forming a process committee, the importance of adopting a management process, and the use of technology only when it benefits the process.

Kline, Vetter, & Barnhill (2012) describe the planning, start-up, operation, and formal review of a Professional Master's program in Computer Science and Information Systems (MS CSIS). This interdisciplinary, industry-driven program was launched in fall 2005. The program review process included stakeholder feedback assessing the program's strengths, weaknesses, opportunities, and threats. Input from the Advisory Board Meeting and the Current Student Focus Group were noted as being particularly well-reasoned, thoughtful, and constructive.

Waguespack (2005) highlights the challenges of striking a balance between breadth and depth of technical and business content in describing the design of an undergraduate Computer Information Systems (CIS) curriculum at a

business college. The program has four major learning tracks: programming and software development; data modeling and database management; systems development, modeling, and design; and net-centric computing. Courses are categorized by learning track and by learning outcome (i.e., introductory, theoretical, technical, or professional). A guiding design principle was to emphasize hands-on IT capabilities while maintaining the theoretical foundations essential for intellectual development and career growth.

Janicki, Cummings, & Kline (2014) recognize the importance of IT/IS courses and curriculum staying current with evolving technologies and relevant to the business community. To that end, they developed a survey instrument for identifying technology needs, knowledge requirements by job category, and hiring expectations by job category. The survey was completed by 225 IT professionals, and results were compared to those from prior surveys administered in 2008 and 2003. The two new job categories added in 2013 were Big Data and Project Management, with recommendations for increased curricular emphasis in these areas. Positions with the largest projected growth were Big Data, Project Management, Business/System Analyst, Database Analyst, Networks & Security, and Software Developers. New skills that emerged were Business Analysis, Database Analysis, and Networking.

Van Auken et al. (2011) developed a gap analysis approach for evaluating IS program relevancy. Ten program emphasis variables, including nontechnical ("soft") and technical ("hard") skills, were used as the basis for the analysis. The program-specific gap deficits identified by IS program alumni included both hard and soft skills and were in the areas of: the ability to develop workable solutions to information system problems, understanding the concepts of the functional areas of a business and how they relate to each other, the ability to communicate effectively using the language of business, and written communication skills.

The above research provides insights concerning how to organize and structure the review process, tools and techniques for gathering and analyzing relevant data, and critical criteria for curriculum evaluation. What differentiates the work presented here is the comprehensive approach to identifying the essential components of an MSIT program and integrating them into the curriculum.

### 3. PROGRAM DESCRIPTION AND PRE-REVIEW CURRICULUM

The MSIT at Bentley University is a 30-hour program consisting of 10 three-credit courses. There are six required core courses, as shown in Figure 1.

- CS603: Object-Oriented Application Development (with Java and Eclipse)\*
  - CS605: Data Management and Systems Modeling (with SQL and Oracle)\*
  - CS607: Technology Infrastructure of Information Systems\*
  - CS610: Enterprise Architecture
  - CS620: Global IT Project Management
  - CS630: Object-Oriented Systems Analysis and Design
- \* Students who have completed comparable coursework may be eligible to substitute electives for these courses

Figure 1: Six Core Courses

- CS612: Web-Based Application Development
  - CS640: Data Communications
  - CS650: Data Management Architectures (including big data and cloud computing technologies/architecture)
  - CS680: Mobile Application Development\*
  - CS753: Business Intelligence Methods & Technologies (data warehousing and data mining)
  - CS801: IT Policy and Management
  - CS881: Internship
- \* CS680 was granted approval at the start of the review process to be offered in spring 2015

Figure 2: CS Electives at the Start of the Review Process

Students also take four elective courses, one of which must be a CS elective. See Figure 3 for pre-review elective offerings.

There are two options for the structuring of the other three electives, as shown in Figure 3. In the first option, the "CS or Related Elective" includes graduate courses from two other IT-related departments. Students with particular career goals in mind can take advantage of the second option, which allows them to work with the program director on designing a concentration that best meets their career needs.

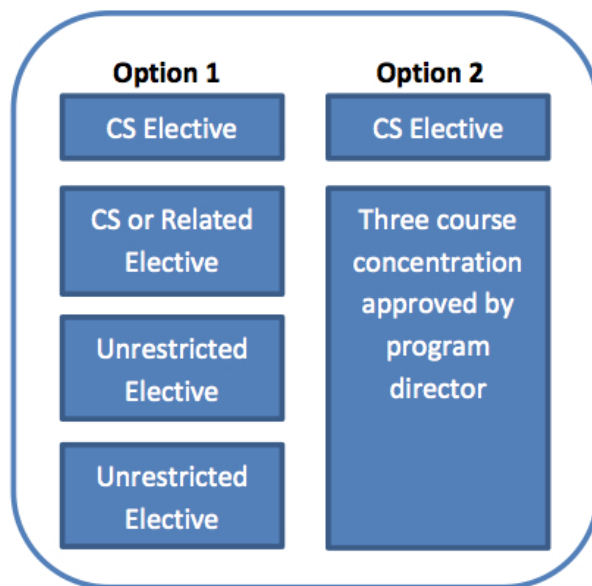


Figure 3: Electives Structure

There is also a dual degree program at Bentley, which combines the MSIT degree with an MBA. Students in this MSMBBA program take the six courses in the core plus the "CS or Related Elective" course.

### 4. REVIEW PROCESS

All of the faculty members who taught in the MSIT program were invited to be part of the review process. One of the critical issues identified at the kickoff meeting was the importance of convening a **focus group** as soon as possible to garner input from industry stakeholders. This group needed to include IT managers who had hired our students as well as those who had not. The inclusion of alumni who fell into both of these categories was also considered to be vitally important.

Another key issue was the necessity of performing a **competitive analysis** of both local and national competitors. This involved a review of program content as well as an assessment of the focus of each program.

**Student input**, including data from exit interviews with and surveys from soon-to-be graduates, were collected. Data from university-administered course evaluations were also included. The students' perspective was considered to be an essential component of the review process.

Findings from all of the above were used in assessing current course composition; the balance between managerial and technical content; and strengths, weaknesses, and gaps in the curriculum.

### COURSE CLUSTERS

To facilitate the course review process, all of the courses in the program were segmented into clusters. Figure 4 shows this clustering, with courses in the core appearing in bold.

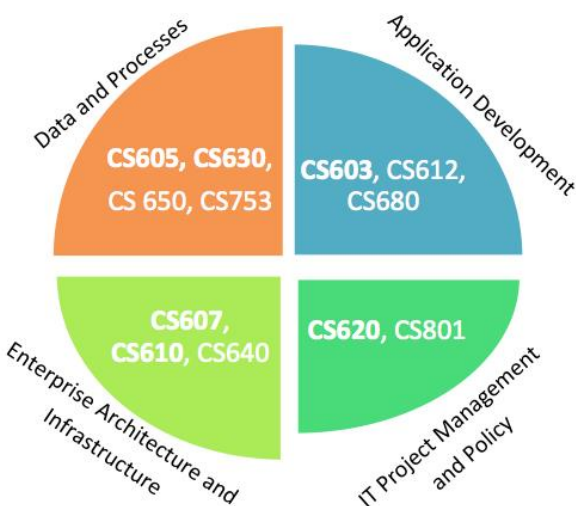


Figure 4: Course Clusters

The MSIT faculty review committee was divided into smaller working groups, each of which was responsible for overseeing the review process for one course cluster. Each team selected one faculty member to be in charge of scheduling team meetings and reporting in at periodic meetings of the full review committee (typically held monthly). In addition, all documentation generated throughout the review process was posted to an intranet site to which all members had full privileges.

### FOCUS GROUP

A focus group was held early in the review process, due to the importance of the outside perspective in defining criteria for the program's evaluation. Twelve industry executives were

invited to participate, including seven alumni of Bentley University (though not necessarily of the MSIT program). Some of the participants had hired graduates of our program in the past, but the majority had not. It was important to have a mix of participants who were willing to be critical in their judgements of the MSIT program in order for the meeting to be most effective.

Prior to the meeting, each participant was sent a link to the website for the program. No other preparatory materials were provided. The MSIT faculty member who led the discussion concentrated first on questions that were not specific to our curriculum, including:

- Program expectations in terms of the topics and content that are deemed essential to graduate education in IT/IS.
- The minimum set of skills required for various careers (analysts, consultants, etc.).
- The types of candidates they would look for from our program as well as from our competitors.

The participants were then presented with descriptions of the courses in our curriculum. They were asked to critique the content, including identifying anything they thought was missing.

The focus group session was recorded and was shared and discussed with the review committee overall and by the individual teams. Several big picture issues emerged from the focus group that helped lay the foundation for the rest of the review process and gave additional direction to each of the teams.

Detailed feedback was also essential in the initial preparation of a document listing the knowledge and skills our graduates should have. The list was divided into three categories: **Professional** (e.g., team player, oral and written communication, persuasion skills), **Managerial** (e.g., agile project management, IT alignment, security management), and **Technical** (e.g., versioning/source control, web services, cloud computing). Each team was charged with identifying the skills and knowledge provided by their set of courses and contributing to the overall listing of skills and knowledge essential to the program as a whole.

### **COMPETITIVE ANALYSIS**

Competitive analyses on a local and national basis were performed along a number of dimensions. These included curriculum, student population, delivery mode, the type of school housing the program, part time vs. full time, technical vs. managerial, and IT vs. analytics.

Findings from the analyses were posted to the intranet for use by the teams in reviewing course offerings and identifying gaps within their clusters. They were also applied to updating the list of items in the program-wide knowledge and skills document.

### **EXIT INTERVIEWS AND SURVEYS**

Every MSIT and MSMBBA student graduating during the review period was invited to participate in an interview and was also asked to fill out a web-based survey. Forty students were interviewed and 43 completed the survey. All interview and survey responses were posted to the intranet.

The questions asked in the interview are included in Appendix A. Students were very forthcoming in expressing their views on the program, with well-thought-out responses on their learning experiences. Some even followed up with the faculty member conducting the interviews to provide further feedback after having embarked on their new careers. Their ideas for improving the program were often aligned with those articulated by the focus group.

The first set of survey questions asked the respondent to rank each MSIT course on a scale from 1 (not valuable) to 5 (valuable). The second set of questions asked students to rank how well the MSIT program helped them develop their skills and knowledge in 19 areas on a scale from 1 (not at all) to 5 (extremely well). The items included here were not an exact match with those in the list developed as part of the review process (which had grown to 38 items by the end of the review period), but they did have key elements in common.

Anonymous responses from the interviews and surveys were posted to the intranet site for consideration by the review team as a whole and the individual course clusters in evaluating the curriculum.

### **OTHER SOURCES OF INPUT**

University-provided data were also incorporated into the program review. These included student

evaluations of teaching, which are administered at the close of each semester via the web and completed on a voluntary basis. Other inputs were enrollment data from Admissions and placement data from Graduate Career Services.

## **5. REVIEW RECOMMENDATIONS AND OUTCOMES**

The curriculum review highlighted a number of strengths in the MSIT program but also brought to light gaps in the curriculum and other areas for improvement. The following summarizes some of the issues that were identified and the recommended actions for addressing them within each of the knowledge and skill categories assessed in the review.

### **PROFESSIONAL**

Issue 1: The need (for all graduate programs) to improve the written and verbal communication skills of their graduates.

Issue 2: The importance of knowing how to be both a team player and a team leader.

Recommendations:

- Add group projects and presentations to those courses that do not already have them but would benefit from their inclusion.
- Include grading criteria on knowing the audience and communicating clearly and persuasively in both oral and written work.
- Provide students with opportunities for assuming different roles within project teams.

### **MANAGERIAL**

Issue 1: The increased emphasis on agile project management in industry should be reflected in the curriculum.

Issue 2: The rising importance of security management should be reflected in the curriculum.

Recommendations:

- Focus on agile management in project management and systems development courses. Structure team projects around the key principles of agile development.
- While security management should be a topic in several courses, it warrants a course devoted specifically to this topic (from both managerial and technical perspectives).

## TECHNICAL

Issue 1: All students should understand the functionality provided by version control systems.

Issue 2: Students should understand the importance of usability and the user experience in system design.

Recommendations:

- Teach version control systems in the core. Provide hands-on opportunities with such systems in more advanced development courses.
- Emphasize the user experience in all development courses and include graded components on designing for usability.

## OUTCOMES

Outcomes from the review have led to changes across the curriculum, including but not limited to the following:

- More group projects with presentation components are being added to both core and elective courses.
- Agile development is being implemented in team projects using the Scrum framework in both the project management and SA&D courses.
- Version control systems are used in the mobile development course (CS680) launched in spring 2015 and will also be used in a newly redesigned web development course (CS612) in fall 2015.
- User experience/usability requirements are being added to the group project in the analysis and design course (CS630) and will be reinforced in CS612 and CS680.
- An experimental course on Network and Systems Security (CS799) was introduced in summer 2015, with the aim of making this a permanent elective.

Many other changes have been introduced or are in the planning stages. The review process has provided us with a roadmap for evolving the MSIT curriculum so that it continues to meet the needs of both industry and our students.

## 6. CONCLUSIONS

One of the most important lessons from the review has been the need to make this an ongoing effort even after the formal process has ended. The perspectives of focus group members and other industry stakeholders continue to be sought out, with alumni being among our most valuable resources. The intranet site created for the review remains active, with updates from student interviews and surveys, information on competing programs, placement statistics, and admissions data posted as they become available. The ongoing challenge is to avoid complacency in our curriculum by continually evaluating where the industry is going and aiming to remain ahead of the curve in IT/IS graduate curriculum.

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## Appendix A: Exit Interview Questions

Name:

Date:

Degree: (MSIT, MSMBA):

Date of graduation:

1. *Have you been able to find a job? If yes, who is your current employer and what is your current title.*
2. *How many job offers did you receive?*
3. *Are you pleased with the job you found?*
4. *How helpful were career services in helping you find internships/jobs?*
5. *What were the most important learning outcomes for you from the MSIT program?*
6. *What didn't you learn from the program that you wish you had learned?*
7. *What were the three best learning experiences (courses, projects, etc.) for you in the MSIT program?*
8. *Were there any major disappointments during the MSIT program? If yes, what were they?*
9. *What, in general, should we do to improve the MSIT program?*
10. *Would you be willing to recommend the MSIT program to others?*