INFORMATION SYSTEMS
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In this issue:

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INFORMATION SYSTEMS EDUCATION JOURNAL

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Abstract

This article describes the creation of the Master of Science of Computer Science and Information Systems at University of North Carolina Wilmington. The creation of this graduate degree was funded by the Sloan Foundation as a new type of program, the Professional Master's. The program was designed with significant industry input, and is truly interdisciplinary, spanning not only departments, but schools and colleges. The planning, start-up, operation, and formal review of the program are reviewed. IS Educators planning or administering graduate programs should benefit from the review of challenges and solutions provided.

Keywords: graduate programs, professional master's degree, curriculum, program planning, program administration

1. MOTIVATION

In the Fall of 2005, the University of North Carolina admitted its first students into the Master of Science of Computer Science and Information Systems degree program. The program was unique for several reasons:

- Interdisciplinary – across colleges
- Professional Science Master's – funded by the Sloan Foundation
- Industry driven

The program has been successful, meeting its enrollment goals, achieving near 100% placement, generating scholarly articles, and providing significant indirect benefits to the university and professional community.

The goal of this paper is to provide a case study reference for the creation of similar programs. To this end, we will describe the program in detail, review the seven years since inception,

discuss challenges encountered, and identify keys to the ongoing success of the program.

2. PROGRAM DESCRIPTION

The Master of Science in Computer Science and Information Systems at UNC Wilmington is a 36 hour program designed to prepare students for advanced careers in the information technology field. The program is delivered jointly by the Computer Science department and the Information Systems faculty in the Information Systems and Operations Management department.
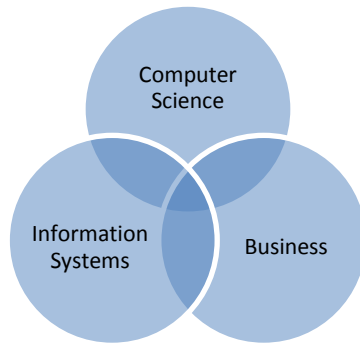
Figure 1

The main strength of the MS CSIS program is its interdisciplinary nature. This was a major motivation in its creation, and is supported by the current feedback from the stakeholders. The Interdisciplinary nature of the program is represented by the Venn diagram in Figure 1.

The three areas have these characteristics:
- Computer Science – technical theory, science, research, academic contributions
- Information Systems – technical application, implementation, professional contributions
- Business – business theory and application

The Venn diagram represents that none of the characteristics are exclusive of any one discipline. Faculty, courses, capstone projects, and students fall in various parts of the Venn diagram. We view this interdisciplinary nature as a strength of the program, creating well-rounded graduates. Traditional single-discipline programs create, for example, business-minded graduates without technical skills, or technical-minded graduates without business skills. This program, furthermore, strives to cover both theory and application, so that graduates are able to apply their knowledge in the workplace.

Curriculum

The program consists of 36 graduate credit hours, in 3-credit hour courses.

Component	Credit hours
Core Courses	18
Capstone	6
Electives	12
	36

The Core is required of all students, and consists of the six 3-credit courses. Each Core class has a specific content pre-requisite that is typically satisfied by some undergraduate MIS or CSC course. The Core and prerequisites consist of:

- CSC 532 Design and Analysis of Algorithms
    - undergraduate Data Structures
- MIS 534 Information Security Management
    - undergraduate Networking or Telecommunications
- CSC 544 Network Programming
    - undergraduate Networking or Telecommunications
- CSC 550 Software Engineering
    - Undergraduate systems analysis OR software engineering
- MIS 555 Database Management Systems
    - Undergraduate database
- MIS 565 Analysis, Modeling, and Design
    - Undergraduate systems analysis OR software engineering

The capstone component can be satisfied with either a Project or Thesis. The capstone is performed under the guidance of a committee of faculty, chaired by a graduate faculty member. The capstone is typically accomplished over two semesters, and represents a significant contribution to the body of knowledge in IS/CSC Academia (Thesis) or IS/CSC Profession (Project). The capstone requires a public proposal and a public final defense. The capstone also requires a significant document in addition to deliverables agreed upon by the committee.

The twelve required elective hours can be made up of:
- CSC/MIS 5XX various offerings
- CSC/MIS 591 Directed Independent Study
- CSC/MIS 592 Topics in Computing
- CSC/MIS 598 Internship

- Other graduate courses aligned with career goals and approved by academic advisor

In addition to specific course prerequisites, there are also significant program prerequisites. These not only give context to the application of core coursework, but also contain the concepts and language used in the core coursework. The program pre-requisites are:

- Introductory Computer Programming
- Intermediate Computer Programming
- Introductory Marketing
- Introductory Management
- Introductory Accounting
- Introductory Finance

The program is considered a Professional Science Master's (PSM) degree and is a member of the UNC Professional Science Master's degrees (http://www.ncsu.edu/grad/psm/). These programs are typically terminal degrees geared towards professional employment, combining Business and Professional curriculum with Science, Technology, Engineering, and Math (STEM) curriculum.

The program is delivered in a manner to serve both part-time local working professionals and full-time students. Courses are offered in the evenings or late afternoons. Where appropriate, courses are offered one evening a week.

The program directly strengthens the Computer Science, Information Systems, and Business degrees at UNC Wilmington:

CSIS Graduate Assistant activities
- assist in CSC undergraduate courses (some serve general campus degrees)
- assist in CSC department technical support
- assist in MIS undergraduate courses (some serve campus and business degrees)
- assist in MIS department, Cameron School of Business technical support
- assist in CSC faculty research (sometimes with other disciplines, e.g. Geography, Psychology)
- assist in MIS faculty research (sometimes with other disciplines, e.g. Finance, Marketing)
- assist in CSC and MIS grants
- co-author research with CSC faculty
- co-author research with MIS faculty

CSIS faculty (CSC and IS) are developed professionally by:
- teaching graduate level courses
- mentoring graduate students
- participating in capstone projects
- developing electives for graduate courses

Less overtly apparent are these benefits to the campus and community:
- CSIS students are employed by other academic departments and non-academic offices on campus
  - Information Technology Services
  - Admissions
  - Housing and Residential Life
  - Continuing Education
  - Graduate School
- CSIS students are employed as interns, part-time employees, and full-time employees by local businesses
  - GE-Hitachi
  - Visionair
  - PPDI
  - Many others
- CSIS students support grants in other disciplines
  - Chemistry
  - Biology
  - Psychology
- CSIS capstone projects have become production systems used by campus agencies
- CSIS students and faculty co-author research with faculty from other disciplines on campus
  - Marketing
  - Psychology
  - Finance
  - Operations Management
  - Mathematics

Organizational Structure
The organization structure is depicted in Appendix 1. In summary, the program is overseen by two main entities: the MS CSIS Program Committee, and the Cameron School of Business Graduate Programs Office. The CSIS Committee is comprised of two Computer Science graduate faculty and two Information Systems graduate faculty. One of the four members is director, with the directorship alternating between CS and IS faculty. The CSIS Committee handles curriculum changes, admissions, and graduate assistantship and scholarship allocations.

The CSB Graduate Programs Office handles operational aspects such as individual degree requirements, payment of graduate assistantships, marketing, reporting, etc. There are synergies of operations among the CSIS program and the other programs within CSB: the International MBA, Professional MBA, and the Master of Science in Accountancy.

Of significant impact to the CSIS program is the organization structure that spans the College of Arts and Sciences and the Cameron School of Business. There are significant differences in funding, procedures, culture, and philosophy that impact the program. As an example of how impactful this is, students are entered into campus information systems as EITHER Arts & Sciences students OR Cameron School of Business students. This determines state formula funding during student coursework and ultimately follows students to commencement, where they attend EITHER Arts & Sciences OR Cameron School of Business commencement.

Another example of the challenges of integrating the two departments is how each views program content. For example, the Computer Algorithms core course was generally viewed as not necessary by the Information Systems faculty, while the Computer Science faculty viewed it as absolutely critical. The Systems Analysis course was championed by the Information Systems faculty, and viewed as low value by the Computer Science Faculty. In the end, the two courses were both included as a compromise.

The organization chart lines represent both formal and informal lines of reporting and/or communications. The purple boxes in Appendix 1 represent the two departments involved. In general, changes to the program are slower and more difficult to achieve than in single-department and/or single-school/college programs. Differences in philosophy or practice between the departments require more discussion to achieve a "meeting-of-the-minds". Fundamental motivations are influenced by differences in funding and compensation between the two departments, for example, teaching load, equipment purchases, department budget, travel compensation, training compensation, publication requirements, etc.

Accreditation

The program falls under UNC Wilmington's accreditation by the Southern Association of Colleges and Schools (SACS,

http://uncw.edu/planning/sacs.html). Furthermore, the program falls under the Cameron School of Business accreditation by the Association to Advance Collegiate Schools of Business (AACSB). The program is also a Professional Science Master's degree, and participates in the University of North Carolina System-wide Professional Science Master's Programs.

The Computer Science department's Bachelor of Science degree is accredited by the Computing Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

3. HISTORY

The Request for Authorization to Establish a New Degree Program was submitted in October of 2004, after several years of planning. The degree officially accepted students in the Fall of 2005. The CSC department had been offering graduate level courses for several semesters, so some early students entered the program with coursework towards the degree program.

The program was initially staffed with 10 tenure-track CSC graduate faculty, and 4 tenure-track MIS graduate faculty. The program is now staffed with 11 tenure-track CSC graduate faculty, and 6 tenure-track MIS graduate faculty. However, several faculty members are in administrative positions that limit their involvement in the program.

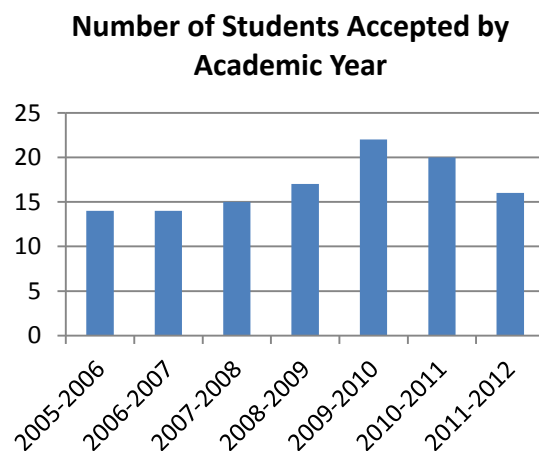**Number of Students Accepted by Academic Year**

Figure 2

Fourteen(14) students were accepted in the first academic year (refer to Figure 2). Admissions generally increased for the first five years, with a high of 22 admissions in the 2009-2010

academic year. Admissions have somewhat fallen, with 16 admissions in the 2011-2012 academic year. As shown in Figure 3, 45 students have graduated from the program (note that 2011-2012 contains expected graduations).
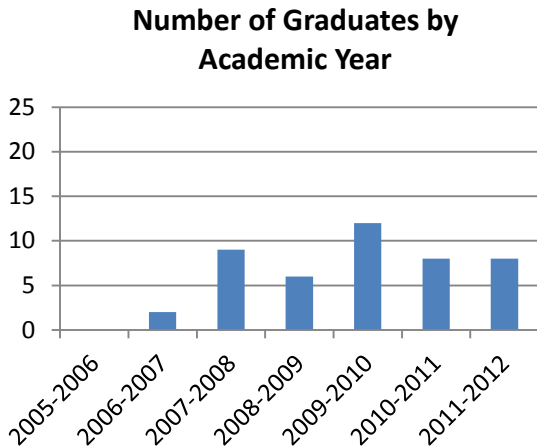
Number of Graduates by Academic Year

Figure 3

Several minor curriculum changes occurred since program inception, the main one concerning capstone projects. The hour requirement was standardized in the catalog so that both Project and Thesis options required 6 credit hours devoted to the Project/Thesis. This catalog change matched practice and made the requirements clearer.

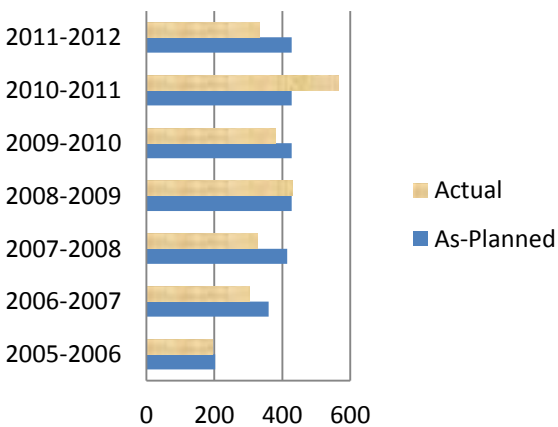**Credit Hours by Academic Year (As-Planned assumes 9 hrs full time and 4.5 hrs part time)**

Figure 4

From the Request for Authorization to Establish document, the program was expected to begin with 20 Full Time and 5 Part Time students, and have, by Year 4, 40 Full Time students, and 15 Part Time students. Steady-state was expected to be 40 Full-Time, and 15 Part-Time students. Figure 4 shows the As-Planned versus Actual credit hours for the program, by year. The program currently has 51 students pursuing the degree, but it is difficult to classify them clearly as full-time or part-time (many began as full-time, are now part-time, but may become full-time again). Figure 4 shows the total planned credit hours versus the total actual credit hours enrolled in by students. In short, the program met its enrollment projections, but has since fallen off from the projected enrollment. This appears to be partly due to the national graduate enrollment trends, and the cancellation of multiple electives in the past year due to resource constraints.

4. OPERATIONS

Recruitment
At the inception of the program, the state of North Carolina participated in a twelve-state consortium called the Academic Common Market. In summary, if the desired degree was not offered in a student's home state, the student could pay in-state tuition at one of the consortium schools. For the MS CSIS degree, this was a significant benefit in our marketing – students from twelve states could pay in-state tuition to come to our program. Unfortunately, North Carolina no longer participates in the Academic Common Market consortium.

From the marketing research and experience of our graduate school, incoming students found out about their program in two main ways: the internet and word-of-mouth. Many of the traditional recruiting efforts have shown to be of little value:

- Campus visits
- Graduate Program Fairs
- Corporate Visits

These recruiting methods have worked well for the Master of Science of Accounting and the Professional MBA program, which draw students mainly from the local community.

Our current marketing efforts focus on two items: creating searchable content on our web site, and actively using social media, mainly

LinkedIn. Each capstone project results in a substantial document that we post on our web site. This effectively builds content, but we have not previously received full benefit because of deficiencies in search-ability. Search engine optimization fundamentals such as review and monitoring of web site statistics, proper meta tags, proper sitemaps, and changing content, are essential. Here are some additional initiatives that we are undertaking:

- Each project has a "landing page" with abstract, cross links to faculty, and can be linked to by other sites. This makes it easy for others to link to individual projects.
- Each pdf document will have a link to the main master's program URL. Without this, the project documents are found, but the program may not be.

We have viewed social media as the combination of the two ways students find programs: the internet and word-of-mouth. In addition to creating Facebook and LinkedIn presences, we have begun to integrate LinkedIn into some of our procedures:

- Announcements of public capstone project proposals and defenses must be made by students on their LinkedIn accounts, and shared with the MS CSIS LinkedIn group.
- Announcements of graduations are posted in the LinkedIn MS CSIS group
- Announcements of published papers are posted in the LinkedIn MS CSIS group
- Faculty are reminded to endorse students, as appropriate, via LinkedIn

Although we cannot directly identify results in recruiting from this new effort, we see other positive benefits. This forces students to consider and develop a professional online presence prior to graduation. Faculty have improved their own online professional profiles to be better references to students. Students give each other virtual "pats on the back" as they complete or announce items. In short, this has shown to have a very positive, albeit mostly intangible effect, that we think will pay dividends in the future.

Scheduling of classes

Classes are scheduled by the individual department chairs, with a preference toward offering late afternoon and evening class times. Conflicts are avoided by the simple agreement that IS graduate classes will be offered on Monday and Wednesday, and CS graduate classes will be offered on Tuesday and Thursday.

However, there are still coordination issues attempting to ensure that the core classes are offered in the same semester each year, and that a sufficient number and variety of electives are offered.

Capstones

Capstone projects are supervised by a committee comprised of a chairperson, and at least two other members. The committee must contain at least one member from the IS faculty and from the CS faculty. The third member can be from IS/CS, from another academic discipline, or an IT professional.

The capstone is meant to contribute significantly to either the IS/CS academic discipline(s) or the IS/CS profession. The capstone can take the form of a Thesis (academic contribution) or a Project (professional contribution).

Six (6) credit hours of capstone are required, and the capstone is typically completed over the academic year (9 months). The first three (3) credit hours are typically used to research and write a proposal, which is delivered in a public presentation. The second three (3) hours are typically used to execute/implement what was proposed, culminating in a public final defense of the capstone.

The capstone element has been labor-intensive, but also extremely valuable and rewarding, for both students and faculty. Capstones have resulted in:

- Published Journal and Conference Proceedings
- Creation of, and improvement to, real-world public and private production information systems
- Job offers specifically based on work from capstones

5. PROGRAM REVIEW

Student Body

Several promising trends were apparent in the review of the student body from 2005 to 2012 (specific statistics available from authors).

- Average test scores (GMAT/GRE) of incoming students rose
- Average Verbal GRE rose
- The gender diversity increased significantly
- The racial diversity increased significantly

- The percentage of non-UNCW backgrounds increased from 7% to 68%

In general, students who desire graduate assistantships have been able to obtain them, either through the CSIS program, or with other academic or administrative departments on campus. Note that in 2011-2012, 6 additional graduate assistantships were available through grants with the Chemistry and Psychology departments

Students who are admitted attend a one-day Orientation at the beginning of the Fall semester. The Orientation includes program information, research presentations from faculty, a Meyers-Briggs assessment, professional etiquette session, and a team-building low-ropes course. Once each Fall and Spring, a Capstone Orientation is held covering the details of topic selection, committee selection, and administration of capstones. At the end of the Spring semester, a Graduation dinner is held (in addition to the UNCW Commencement) to celebrate graduates along with their families. A variety of other activities are available to them through the departments: IT Career Night, Wilmington IT Exchange and Expo, Business Week, IT Advisory Board Meeting, and ad hoc meetings with IT professionals.

In general, funding is available for students to give research presentations. However, the MS CSIS program does NOT have a budget to fund student travel. The funding is procedurally difficult to obtain, coming from multiple sources, each with their own requirements and procedures. Sources for student funding include:
- the Cameron School of Business
- the Information Systems and Operations Management Department
- the Computer Science Department
- the UNCW Graduate School
- the UNCW Graduate Student Association
- ad hoc grants

Assessment
The CSC and ISOM departments collaborated to establish the following learning objectives for the program:
1. Discipline Specific Knowledge, Skills, Behavior and Values
2. Critical Thinking
3. Communication

These learning objectives are measured with the following instruments:

- Content Knowledge Assessments for each of the Core Classes
  - 10 questions from each Core class
  - Administered at completion of degree (previously at end of course)

- Oral Communication Assessments
  - In two courses: Systems Analysis and Software Engineering
  - Oral communication rubric completed by instructor for oral presentations

- Capstone Project/Thesis Evaluations
  - Completed by each committee member at final defense

In general, the assessment instruments have been helpful in summarizing information across students and courses. Rather than making decisions on individual faculty's anecdotal observations, decision making is improved with more rigorous analysis.

Program Objectives were established by collaboration among the faculty of the CSC and IS areas. The Program Objectives are also aligned with the UNCW Strategic Goals. The Program Objectives are kept in mind as event, curriculum, and administrative decisions are made.

The Program Objectives are:
- Increase dialogue between industry and the MS CSIS Program
- Provide learning opportunities for faculty
- Improve student recruitment

Stakeholder Feedback
As part of the program review, the following activities were planned and executed:
- IS/MSCSIS Advisory Board Meeting Breakout (Feb 1, 2012)
- Program Review Kickoff Meeting (Feb 3, 2012)
- Current Student Focus Group (Feb 16, 2012)
- ISOM Faculty Meeting Feedback (Feb 24, 2012)
- CSC Faculty Feedback (March 5, 2012)

In particular, the IS/MSCSIS Advisory Board Meeting and the Current Student Focus Group offered well-reasoned, thoughtful, constructive feedback.

The bullet items below summarize the feedback from all these stakeholders.

Strengths
- Interdisciplinary nature of program
- Applied nature of program
- Smaller size of program
- Student Aid (assistantships)
- Placement of graduates / Job opportunities
- Ability to personalize program/flexibility
- Quality of faculty
- Professional networking opportunities
- Friendly and helpful staff
- Wilmington location – tourist destination

Weaknesses
- Lack of Global IT component
- Too few electives
- Faculty resources (too few faculty)
- Lack of an "integrative" class
- Cross-listing of courses; very similar graduate/undergraduate courses
- High Variability in entering student skill sets (technical, business, and applied)
- Lack of discretionary program budget
- Large number of pre-requisites
- Large class sizes (in some cases) / variability of class size

Opportunities
- Foreign student recruitment
- Recruitment outside UNC Wilmington
- Upcoming undergraduate IT major
- Economic recovery
- UNCW's goal of developing graduate programs
- Graduate Business Certificate – (easier to achieve business pre-requisites)

Threats
- Faculty Workload
- Conditional Admits
- Exhaustion of local market
- Lack of involvement from some faculty
- Divide between CSC and IS faculty / departments
- Hardware and technical support
- Changing technologies

Suggestions
- Benchmark more closely with other Prof Science Master's degrees
- Make capstone projects optional (due to too few faculty)
- Include Professional mentoring as part of program
- More teamwork
- More case study methodology
- More Microsoft / .Net – less Java
- Student-to-student mentoring

Many of the positive AND negative items above come from the fact that the program is very broad and serves multiple purposes:
- Full-time students & Part-time students
- PhD-bound students & profession-bound students
- Multiple technology foci: telecommunications, software development, project management, etc.
- Multiple student backgrounds & skillsets: MIS / CSC
- Content from multiple disciplines: MIS/CSC/Business
- Theory & Application

Academic output (research from)

Table 1 lists the research that is attributable to the program. This research mainly comes from capstone projects and theses, but also comes from classroom assignments, or independent studies. The research outlet for most is refereed conference proceedings, but also includes refereed journal articles in journals such as Computer, Journal of Information Systems Applied Research, and Journal of Information Systems Education.

Table 1

Year	Ref'd Jrnl Articles	Ref'd Conf Proc
2012	3	
2011		5
2010		7
2009		4
2008		8
2007	1	5

Placement

Graduates of the program are well-received by employers. Forty five (45) students have graduated since inception, with 98% employment within the IT profession. (During the economic downturn, employment was not necessarily immediate upon graduation.) In fact, many students accept employment offers before graduating. The average starting salary for graduates since 2005 is approximately $60,000. The average starting salary for graduates from Fall 2009 to the present is approximately $63,000. Employers include, but are not limited to:
- Pharmaceutical Product Development, Inc. (PPDI)

- GE-Hitachi
- Corning
- New Hanover Regional Medical Center
- TriTech
- TranS1
- ATMC
- UNC Wilmington
- Construction Imaging
- Speciality Soft
- Guilford Mills
- Engineering Software Solutions
- Cloudwyze
- American Eagle
- Deloitte and Touche
- Price Waterhouse Coopers
- AT & T
- DAK Americas
- SciQuest
- Credit Suisse
- CTG
- LabAnswer
- Lideli (Japan)

The placement covers a wide range of industries and professions. Industries covered include:
- Banking/Finance
- Software Development
- Engineering
- Healthcare
- Manufacturing
- Education
- Retail
- Information Technology
- Consulting
- Telecommunications

6. CONCLUSION

The creation of the Master of Science of Computer Science and Information Science degree has been challenging and rewarding. The program is truly interdisciplinary, which has created many of the challenges, but has also generated many of the rewards.

The program has aided many alumni in their professional careers. In addition the program has had positive impact on the departments, undergraduate students, the university, and local IT professionals and organizations.

The formal review of the program was a positive experience, confirming our judgment that the program was fundamentally well-conceived and implemented. However, numerous potential improvements were identified. Because the program is still relatively young, there are many operational inefficiencies that need to be refined.

At a more strategic level, recruitment is an area that could dramatically improve many aspects of the program. A larger applicant pool will improve program metrics and outcomes, as well as have positive cultural effects on the student body, departments and university.

Appendix 1: Organization Structure