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Are We There Yet?

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Executive Summary

Children in the back seat on a long trip are not the only ones asking the question “Are we there yet?” At Murray State University (MSU) and other universities starting new programs, the question becomes one of validation of the program. In the late 90s, MSU, a midsize university, was entrusted with the responsibility of developing a program of distinction with financial support from special state funds. The objective of this program was to establish a high-quality, interdisciplinary technical and business, undergraduate and graduate curriculum in telecommunications system management.

A review of literature concerning academic technology disciplines revealed that most authors agree there is a continuum of computing disciplines from purely technical programs such as Electrical Engineering (EE) to highly business oriented programs such as Management of Information Systems (MIS) with telecommunications falling somewhere within the continuum. As the MSU Telecommunications System Management (TSM) program was conceived to be an interdisciplinary program of business and technology, we have asked ourselves where it resides in this continuum. The focus of our review centered on where the TSM program would fit in the continuum in relation to computer science (CS), information systems (IS), and information technology (IT) programs, all of which are established academic disciplines from which the initial MSU curriculum was drawn.

To articulate the unique value the TSM program must provide to its students in order to be recognized as a “program of distinction,” MSU needs to know where the program is in relation to established academic disciplines. This paper examines the curriculum directions taken at MSU in the undergraduate Bachelor of Science (BS) and graduate Master of Science (MS) programs several years after its creation, in an extremely dynamic discipline, in order to understand what the TSM program is currently offering students. With this understanding, the TSM BS program was analyzed using the methodology published in the Journal of Information Technology Education Volume 3 article: An empirical comparison of baccalaureate programs in computing (Reichgelt, Lunt, Phelps, Salzinski, & Willis, 2004). Statistical analysis of the TSM program when compared simultaneously to typical computer science (CS), information systems (IS), and information technology (IT) programs indicates there is a significant difference in the program; however, when compared to each of these programs individually, the significant difference was not as strongly indicated. Using this research, a strong empirical argument can be made that the TSM program is different from CS, but empirical arguments that it is significantly different from the average IS or IT programs are not as strong. Therefore MSU can not use this methodology to articulate its unique value in comparison to IS and IT. The

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new TSM program, like most new programs in non-established academic disciplines, can be thought of as distinct simply because it was designed to be different, the "old intangible argument". As the academic community does not have an accredited telecommunications model as in CS and IS (Association for Computing Machinery, 2005), nor an emerging one such as in IT (Hart, 2006), how does MSU articulate the value of its program to both students and potential employers using empirical data? Additionally, there is neither an established model such as the Computing Program Academic Model (CPAM) proposed by Anthony (2003), nor an accepted empirical methodology in place to provide MSU a foundation to make a tangible case for the program's value to students and industry.

Keywords: telecommunications, education, curriculum, academic, discipline

Introduction

Can we put a stake in the ground? Not in the telecommunications industry. Changes in technology and government regulation continue to transform the telecommunications industry at an unprecedented rate. Voice communication was once the primary service of the industry; "convergence," the transmission of data, graphics, and video over the same networks, is now commonplace. This industry now encompasses networks of leading-edge technologies such as wireless, fiber optic, satellites, cable, and, of course, copper, which connect computers and allow organizations and individuals throughout business and industry to communicate instantaneously around the world. New technology will continue to transform this industry. The installation and upgrading of fiber optic and wireless networks continue to bring ever-faster communications to residential and mobile customers. The boundaries between the telecommunications provider and internet provider are disappearing as internet providers (e.g., Vonage) now offer 'Voice over Internet Protocol (VoIP) phone services and wireless providers (e.g., Cingular and Verizon) offer email, audio and video downloads, as well as web surfing capabilities. How long before live television is available on your cell phone? Oops, an internet search reveals that mobile TV is now available. What was that comment about a stake in the ground?

Since the telecommunications industry provides the architectural structure for today's business and personal activities including e-mail, e-commerce, e-banking, video conferencing, telemedicine, data interchange, asset tracking, on-demand video, web casts, pod casts, video casts, VoIP, and a host of other traditional and new uses for business and industry, people qualified to design, implement, and maintain such systems are in very high demand. In 2000, U.S. Department of Labor (2000) statistics forecast that between 1998 and 2008, telecommunications industry employment was expected to grow 23.4%. Looking closer at the data, telecommunication system management was expecting a 37.3% increase; and related systems analyst, engineer, and scientist positions were expecting a 71.5% increase.

Because of this projected growth, in 1998 MSU decided to respond to a request from the state to develop a program of distinction in this field with support from special state funds. The objective of the proposed program was to establish a high-quality, interdisciplinary technical and business undergraduate and graduate curriculum in Telecommunications. The proposal was accepted and the Murray State University Telecommunications System Management (TSM) program came into existence.

As the initial TSM curriculum was developed, it was recognized that telecommunications systems managers' responsibilities and skills were changing rapidly along with the industry. Given that ever changing environment, the curriculum architects knew the TSM students must develop comfort with uncertainty and change but still be able to make effective decisions. The curriculum architects believed the TSM graduate must possess foundational knowledge for effective problem solving in the following areas:

- Industry regulations
- Networking technologies
- Electronic commerce (B2B, B2C, C2C, etc.)
- Customer service
- Product and project management
- Total quality management
- Return on investment
- Strategic business advantage
- Tools, methods, and applications

Therefore the TSM curriculum was developed with these objectives:

- Graduates must not only be capable and informed; they must also be creative and flexible
- Graduates must be able to manage change in a diverse, rapid-paced, global economy
- Above all, graduates must accept that education is a lifelong journey that continues well after graduation.

Where Are We?

The first students entered the program in the fall of 1999. In two years, the TSM program had solid enrollments in the undergraduate and graduate programs, using primarily conventional campus sections with distance delivery of some courses. A Center for Telecommunications Systems Management was established to support the program. In addition to marketing the program, the center held conferences, seminars and training programs in the telecommunications field. Other than publishing a journal, the program had achieved the objectives set by the original proposal to the state.

Fall 2005 enrollment figures show 207 undergraduates and 29 graduate students. The undergraduate program enrollment has shown steady growth, however, the terror attacks on the U.S. on 9/11/2001 made it more difficult for international students to enter the country which has subsequently decreased the number of international students in the graduate program. The academic program was designed to be truly interdisciplinary, combining the strengths of the College of Business and the College of Technology. The initial curriculum incorporated existing courses with relatively few new courses, packaged to give the students a composite set of business and technical competencies to compete in the telecommunications market. In the fall of 1999, anyone entering the job market who could spell “dot.com” was employable. However, while the initial class was going through the curriculum, the “dot.com” bust changed the job market. New jobs were still being created, but there were now many experienced human resources available.

The TSM program has both undergraduate and graduate curriculum committees tasked with ensuring the curriculum remains current and relevant. With the changing job market and typical “resource availability” crunches, both the graduate and undergraduate TSM curricula have evolved. While changes are still planned, the rate of change has decreased. The curriculum published in the *2003-2005 Undergraduate Bulletin* promises to be stable enough that by the time students graduate using it, their advisors will have filled out far few substitution forms for them over their four years, then the advisors did under previous catalogs. The graduate program plans to reach the same state for students using the curriculum published in the *2006-2008 Graduate Bulletin.*

Undergraduate Program

The mission of the undergraduate program is to graduate students with the insight and ability to function throughout the telecommunications industry.

Table 1 lists the required core of 20 courses, comprising 59 semester hours. Nine of the required courses, 27 hours, come from accounting (ACC), computer information systems (CIS), computer science (CSC), economics (ECO), finance (FIN), management (MGT), and marketing (MKT). Of these nine, eight were in the initial curriculum, reflecting the stability of the business core in the curriculum. Of the eleven TSM courses listed, only two remain from the original curriculum.

Table 1. TSM Undergraduate Core Courses

ACC 200 Principles of Accounting I ACC 201 Principles of Accounting II CIS 304 Principles of Information Systems CIS 307 Database Design & Implementation CSC 232 Visual Basic Programming I ECO 335 Economics & Public Policy of Telecomm. FIN 330 Principles of Finance MGT 350 Fundamentals of Management MKT 360 Principles of Marketing	TSM 099 Freshman Orientation TSM 118 Telecommunications Electronics I TSM 120 Introduction to Telecommunications TSM 132 Network Technical Support TSM 218 Telecommunications Electronics II TSM 232 Network Operating Systems TSM 241 Voice & Data Networking Essentials TSM 343 Protocol Analysis TSM 380 Internship TSM 443 Telephony TSM 450 Telecomm Policy & Strategies

Additionally, students choose two areas of specialization (See Table 2), based on their interests. These options comprise the 24 additional hours the students take to supplement the core 59 hours of the curriculum. The specialty options are: wireless communications, industrial networking, network security and system administration, or additional business courses. Table 2 lists the courses the student takes in each area of specialization.

Table 2. TSM Undergraduate Selected Emphasis Courses

Wireless Communications TSM 321 Wireless Communications I TSM 322 Wireless Communications II TSM 323 Wireless Mobile Internet TSM 423 Wireless Satellite Communications Industrial Networking EMT 310 Programmable Logic Controllers EMT 312 Industrial Instrumentation EMT 455 Industrial Controls Network Security TSM 340 Information Security Management TSM 352 System Security TSM 353 Network Security TSM 441 Advanced Information Security	System Administration CSC 310 Database Administration CSC 360 Scripting Languages CIS 530 Systems Planning TSM 411 Network Design, Operations, & Management Approved Business Electives ACC 308 Accounting Information Systems MGT 358 Entrepreneurial Business Plan Development MKT 475 Marketing Strategies in eCommerce

Masters Program

The mission of the Masters program is to graduate students with the technical, financial, and project management competencies necessary for development and implementation of successful telecommunications network solutions in both the private and public sectors. Graduates are prepared to be highly valued participants in the market as effective providers and well-informed purchasers of integrated telecommunications applications in a wide variety of settings.

The TSM Masters degree requires a 30 credit-hour program. All students must take the eight graduate core courses (See Table 3) and two additional electives (See Table 4).

Table 3. TSM Masters Core Courses

TSM 601: Telecommunications Principles	TSM 602: Telecommunications Systems
TSM 603: Telecommunications Project Management	TSM 610: Network Management
TSM 630: Telecommunications Legal Environment: Law, Policy, & Regulation	TSM 680: Telecommunications Solution Development (18 hours of prerequisites)
ACC 604: Quantitative Financial Controls	MGT 651: Seminar in Organizational Behavior

Table 4. TSM Masters Electives

ACC 608 Accounting Information Systems	MKT 667 Marketing Planning & Application
CIS 609 Data Warehousing & Data Mining	MKT 675 Marketing Applications in E-Business
CIS 645 Decision Support & Expert Systems	MKT 685 Business Geographics for Managers
CSC 607 Distributed Database Applications	TSM 615 Information Systems Security
ECO 625 Managerial Economics	TSM 670 Applications Programming
FIN 612 Capital Investment Analyses	TSM 688 Telecom Systems Practicum

The graduate curriculum has undergone many changes from its original form with the change of the capstone course leading the transition. TSM 680, the capstone course, requires students to use project management processes involving technical, financial, and managerial capabilities to develop an integrated communications network solution proposal that meets voice, data, and video requirements. Successful completion of this proposal development requires competencies learned in the TSM curriculum with emphasis in requirement analysis, solution design, solution implementation, and solution management. Therefore, the student is required to take the following prerequisites: ACC 604, MGT 651, TSM 601, TSM 602, TSM 603, and TSM 610. The sequencing of the prerequisites is shown in Figure 1.

Figure 1 lists the competencies that the TSM graduate should possess as a result of the program, which are also exercised in the TSM 680 capstone course. The TSM graduate program went through a competency evaluation of its curriculum using a progressive scale of 0 to 3. In this scale; 0 indicates no knowledge in the competency, 1 indicates definitional knowledge, 2 indicates an ability to apply and 3 represents an ability to understand and explain the competency. The curriculum developers and primary instructors provided the entry and exit competency ratings for their courses. A mapping of the prerequisite exit competencies into the capstone course is shown in Figure 2. Note that some competencies have values of 2.5 or 2.8, these competencies are the composite of sub-competencies. The mapping illustrates that the competencies are often shaped by multiple courses. The TSM faculty feel strongly that the wide and diverse range of competencies provide both the foundational knowledge and the skills the TSM graduate will need to be comfortable with the uncertainty and rapid pace of change within the telecommunications industry.

As evidenced in this paper, the TSM program has updated its curriculum to stay current with industry. However, to support the declaration of the TSM program as “a program of distinction,” the MSU faculty needs a more substantial position than “we keep our curriculum current.”

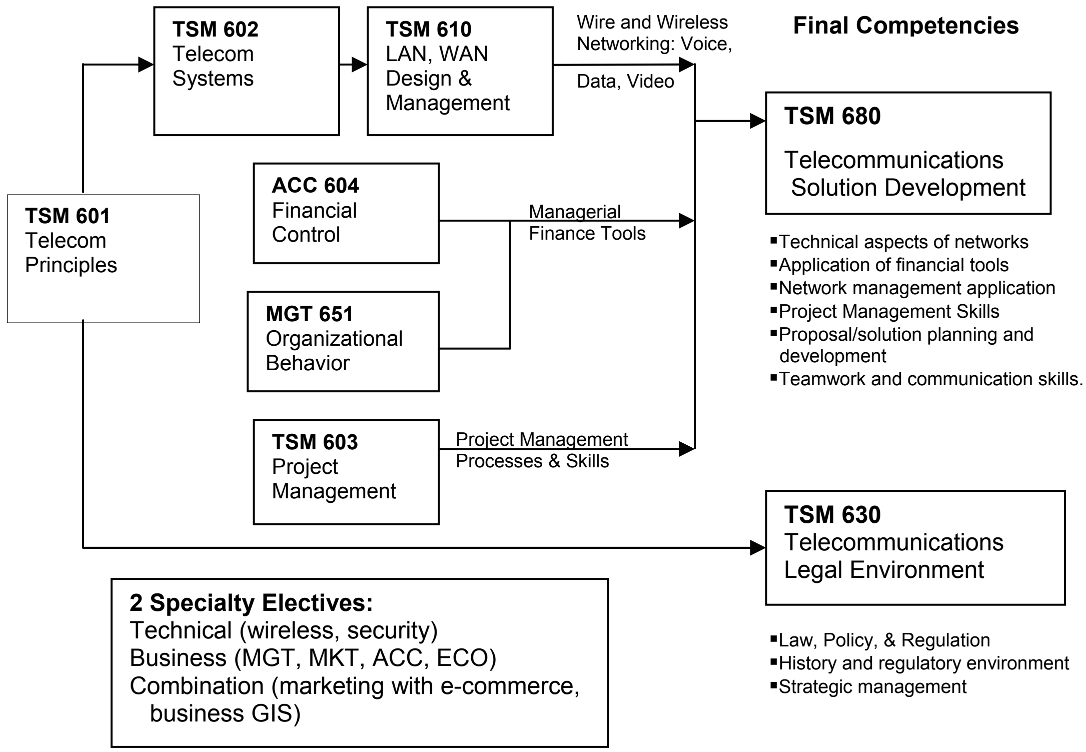

Figure 1. MS Curriculum Flow

Where Are We Going?

In the world of academic disciplines, where does the TSM program reside? There are many traditional disciplines such as Computer Science (CS), Information Systems (IS), Management Information systems (MIS), Computer Engineering (CE), and Electrical Engineering (EE) among others that have established accrediting agencies and are related to the TSM curriculum. There are newer and emerging disciplines such as Information Technology (IT), Information Technology Management (ITM), and Information Resource Management (IRM), which are also related to the TSM curriculum.

In trying to determine if a significant difference exists between baccalaureate programs in CS, IS and IT, Reichgelt *et al*. (2004) give a solid argument for a bottom-up comparison versus a top-down comparison. Looking at a top-down methodology, the researchers listed the skills and capabilities of CS, IS, and IT graduates as defined by their accrediting agencies and concluded that while each discipline has specific and generally accepted definitions of the skills and capabilities, the comparison of the programs from the top-down relies too much on subjective interpretations. Therefore they describe a bottom-up approach to determine if a significant difference exists between the programs.

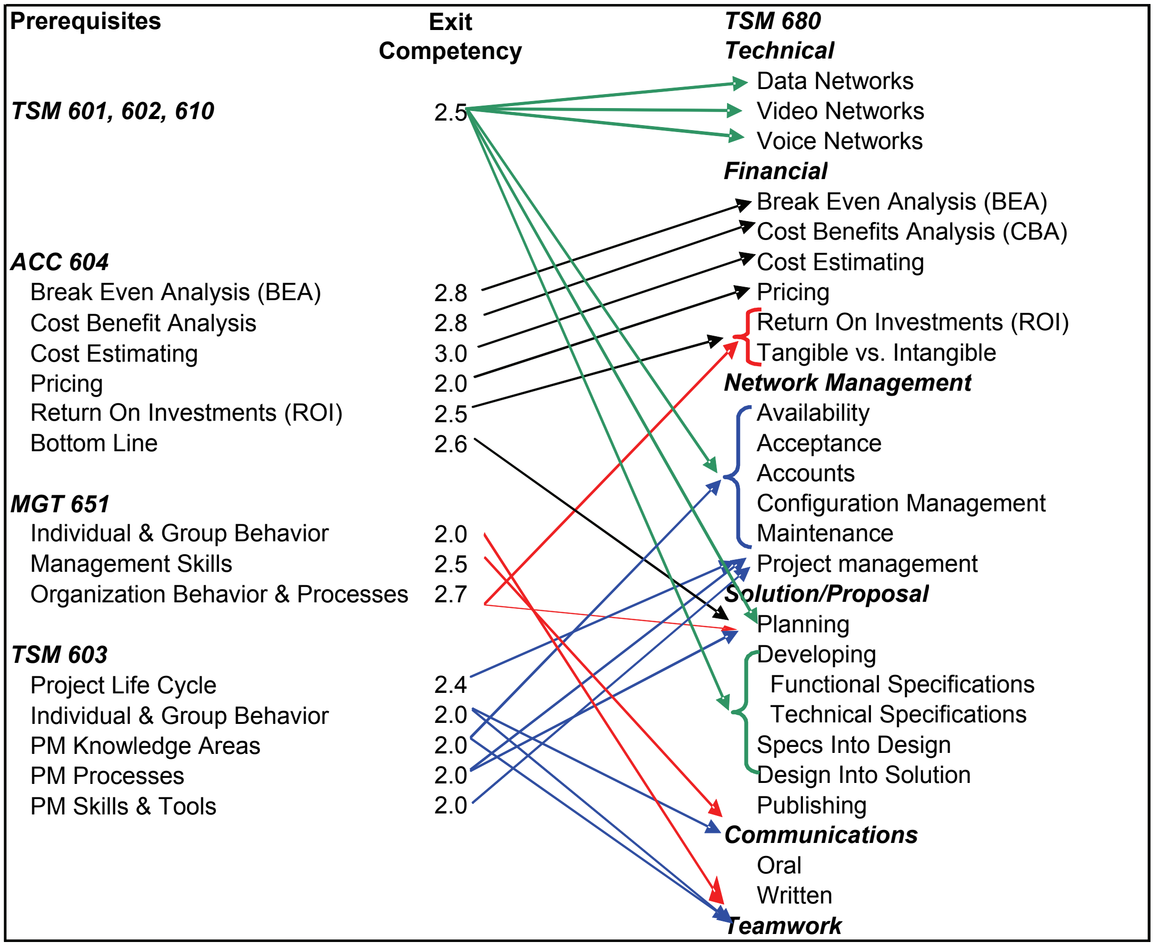

Figure 2. TSM 680 Prerequisites Competencies Map

Lunt, Helps, Lawson, and Goodman (2002) classified courses in the programs into seven categories and supported the decision to use these classifications. .

1. Business (B)
2. Interpersonal communications (IC)
3. Network, web-related technologies or databases (NWD)
4. Electronics & signals (ES)
5. Hardware (HW)
6. Mathematics and Science (MS)
7. Software related courses (SW)

Using these topics, they analyzed eleven schools offering degrees in CS, IS, and IT using a methodology where a three-semester credit hour course is defined as the base unit. Therefore, a four-semester credit hour course has a value of 1.3 and a five-semester credit hour course has a value of 1.67. Their average results are shown graphically in Figure 3, and the results contain no major surprises. As one might expect, information systems placed lower in the software area than in the business area, while computer science was higher in the software area than in the business area, and information technology was highest in the networking area.

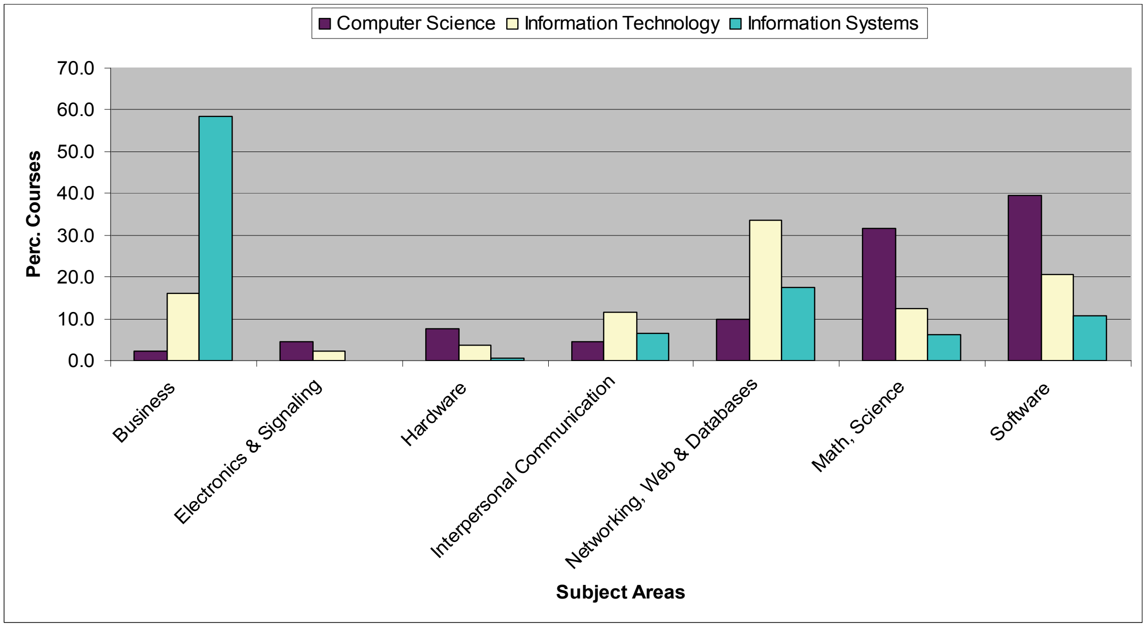

Figure 3. Breakdown of courses in each area for computing programs

Examining the averages listed in Table 5 for the programs in the eleven schools, chi square analysis data reveals that there is a highly significant difference between the distribution of courses based upon subject areas between the average IT, CS and IS programs ($\chi^2 = 33.91$, df = 12, p = .0007) (Reichgelt et al., 2004).

Table 5. Distribution of courses between average programs in CS, IS, and IT

Average	B	ES	HW	IC	NWD	MS	SW	Total
CS	0.59	1.16	1.95	1.13	2.54	8.06	10.03	25.46
IS	14.33	0.00	0.17	1.58	4.27	1.50	2.63	24.48
IT	4.13	0.55	0.92	2.96	8.60	3.16	5.23	25.55

Reichgelt et al. (2004) also performed chi-square analysis on the distribution of courses in the different categories for each of the program types. They found no significant differences among programs in IS, significant differences for programs in CS, and highly significant differences for programs in IT. They concluded that these differences could be explained by the number of curriculum models available for each of the programs. As most IS programs are offered in business schools that seek accreditation by the Association to Advance Collegiate Schools of Business (AACSB), they would follow that model. On the other hand, for the CS programs there are a large number of skills, knowledge units, and computing concepts that must be grouped and presented in a limited number of contact hours, leading to major differences in CS programs. As an emerging academic discipline without an accrediting agency, IT has no accepted curriculum model (Reichgelt, et al., 2004), making the highly significant differences not unexpected.

Table 6. Murray State University TSM Analysis

	TSM Core							
	B	ES	HW	IC	NWD	MS	SW	
	ACC 200	TSM 118			CIS 307		CSC 232	
	ACC 201	TSM 218			TSM 132			
	ECO 335				TSM 232			
	FIN 330				TSM 241			
	MGT 350				TSM 343			
	MKT 360				TSM 443			
	CIS 304							Total
	7	2	0	0	6	0	1.3	16.3
	TSM Electives							
Wireless		TSM 321			TSM 323			
		TSM 322			TSM 421			
	0	2	0	0	2	0	0	4
Industrial		EMT 312	EMT 310		EMT 455			
	0	1.3	1.3	0	1.3	0	0	4
Sys Ad-min	CIS 530				CSC 310		CSC 360	
	TSM 411							
	2	0	0	0	1	0	1	4
Net Secu-rity					TSM 340			
					TSM 352			
					TSM 353			
					TSM 441			
	0	0	0	0	4	0	0	4
Business	ACC 308							
	MGT 358							
	MKT 475							
	3	0	0	0	0	0	0	
Sub-total	5.00	3.33	1.33	0.00	8.33	0.00	1.00	19.00
Ratio	2.11	1.40	0.56	0.00	3.51	0.00	0.42	8.00
Total	9.11	3.40	0.56	0.00	9.51	0.00	1.72	24.30

MSU put together the TSM curriculum without a model curriculum to follow. So how does the TSM baccalaureate program compare to the average IT, IS, and CS programs used in Reichgelt's (2004) study? Using their methodology and the TSM curriculum, an analysis reveals the following scores for the TSM program for the 7 categories. (See Table 6). Note that CSC 232 in the software column is a four semester hour course so it gets a value of 1.3. The core courses totals 16.3 units representing 49 semester credit hours. Ten semester hours of the core courses were not counted as part of any category. The electives courses were placed in the respective column and then the total of units for each column was used to calculate a ratio to the eight units (24 semester credit hours) needed to complete the electives. As an example: the elective business value of 2.11 = 5/19*8 is then added to the core business value of 7 to get a total business value of 9.11. We believe this methodology provides an appropriate value for each column that represents the portion of the curriculum that fall into each of the seven categories. We show the TSM values in comparison to the average IT, IS, and CS programs (See Table 7). The bar graph in Figure 4 of this data shows what appear to be significant differences in most individual subject areas.

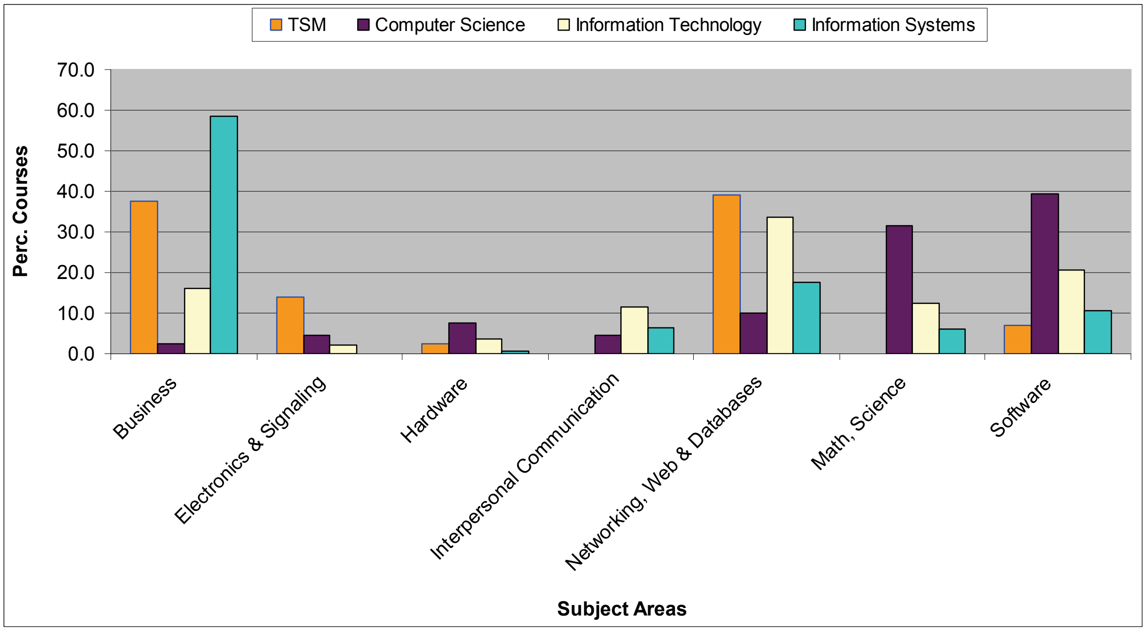

Figure 4. Murray State TSM and Reichgelt et al.'s (2004) averages

The bar graph confirms that the original intent of the TSM program to develop a curriculum with emphasis in business and telecommunications technology has been met. The TSM curriculum showed high scores in "Business" and "Networking, Web, and Databases." The TSM program wanted a well rounded graduate, and Figure 4 and Table 7 shows the TSM program with positive scores in three of the other five categories. The TSM program requires its students to take certain math and communication courses in their general studies, which according to Reichgelt et al.'s (2004) methodology, could not be included in computing the program scores. As they acknowledged, the determination of which if any general studies courses to include in their methodology is one area where their methodology needs additional research.

Using the TSM and Reichgelt et al.'s (2004) data, shown in Table 7, chi-square analyses were performed.

Table 7. Comparison of TSM with Reichgelt et al.'s averages

Program	B	ES	HW	IC	NWD	MS	SW	Total
CS	0.59	1.16	1.95	1.13	2.54	8.06	10.03	25.46
IT	4.13	0.55	0.92	2.96	8.60	3.16	5.23	25.55
IS	14.33	0.00	0.17	1.58	4.27	1.50	2.63	24.48
TSM	9.11	3.40	0.56	0.00	9.51	0.00	1.72	24.30

We used the TSM and Reichgelt et al.'s (2004) data, shown in Table 7, to perform chi-square analyses in the manner of Reichgelt et al. Potential issues exist however with this combination of data and analytic technique. While noting chi-squared analysis is normally performed with integer counts in the cells, we believe the data in the cell represents the count of units and are non-integer because of two factors. First, courses that are not three semester hours represent a fractional part of a unit. Second, with multiple elective options a weighted average of units was applied to obtain the number of elective units for each category. The core and elective counts are then added to get the final count of units. Additionally, a more serious concern in using chi-square analysis on this data is the number of counts that are below 1. The TSM data includes 43% of its cells having a value less than 1. In regard to both of these issues, chi-square analysis of this data may be questionable and produce unexpected results.

The question still remains; where is the TSM program now?

In his article, Anthony (2003) utilized a similar methodology, using credits instead of semester hours but with only three categories: computing credits, math credits, and business credits. In his paper, he developed a Computing Program Academic Model (CPAM) for academic computing programs by analyzing the tradeoff between theory and application as well as business and technology (see Figure 5). The four corners on the model represent disciplines with high emphasis in the intersection of two of the areas of interest. Programs with varying emphases would lie in the interior of the model based on their emphasis. Computer science is in the lower left hand corner, representing the intersection of theory and technology; information technology is in the lower right hand corner, representing the intersection of applications and technology. The position of these programs at the bottom of the model indicates that these programs do not focus on business. Information Systems, however, falls in the middle of the model indicating its focus on technology is not as strong as either CS or IT and that it has a stronger focus on business than either of the other two programs. Anthony supports that the differences in the programs are significant by comparing the differences in the math, business, and computing credits within the programs.

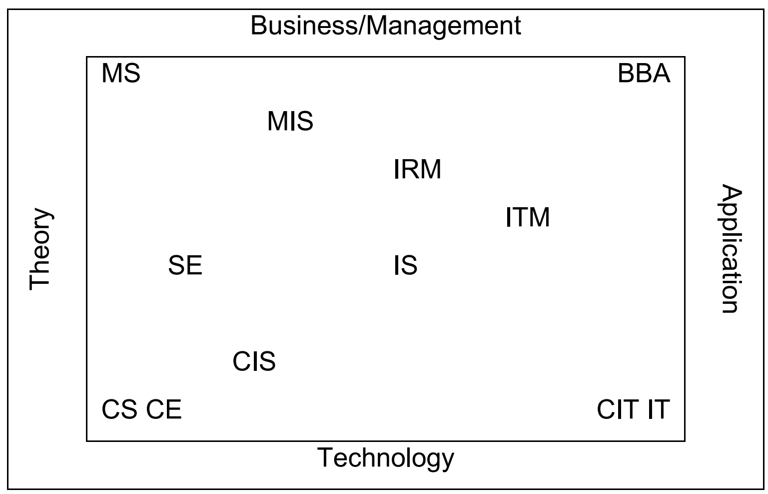

Figure 5. Computing Program Academic Model (CPAM) Anthony (2003)

Where does the TSM program reside in the CPAM model? An answer is not yet available. Anthony (2003) noted no significant difference between information technology and computer science programs using his methodology which is contrary to program design and conventional wisdom and would place IT and CS next to each other in his model. Using Reichgelt et al.'s (2004) averages in Table 8 for IT and IS and running a chi-square analysis shows that there is no significant difference between the average IT and IS programs (χ^2 Test statistic = 10.01, χ^2 Critical value = 12.59, df = 6, p = 0.12417) which would lead us to believe IT and IS would be in the same approximate location in Anthony's (2003) CPAM model. However, as noted earlier, these chi-square results may be suspect as the IT and IS data each have two cells with values of less than one. This finding supports Reichgelt et al.'s (2004) assertion that additional research is needed to develop an empirical methodology to differentiate between the disciplines.

Table 8. Reichgelt et al.'s (2004) averages

Program	B	ES	HW	IC	NWD	MS	SW
IT	4.13	0.55	0.92	2.96	8.60	3.16	5.23
IS	14.33	0.00	0.17	1.58	4.27	1.50	2.63

Where do other Telecommunications programs reside in this model? Some schools such as the United States Military Academy at West Point, New York have created an Information Technology Program (Alford, Carver, Ressler, & Reynolds, 2004) that has included Telecommunications but is so flexible that it could be in several locations on the above model. The program has 15 depth threads, including two foundation threads: Computer Science and Electrical Engineering and additional threads including Networks, Telecommunications, and Robotics. The IT major must complete one foundation thread, three additional depth threads, and an integrative experience. Based on the selection of threads, a West Point student could have a Telecommunications theme for his or her program with either foundation thread. However, the West Point Telecommunications major's lack of business courses would mean that the TSM and West Point Telecommunications graduates would be far apart on Anthony's (2003) model and may be significantly different using Reichgelt et al.'s (2004) methodology.

Anthony (2003) suggests that a model such as CPAM is needed by academia to articulate career opportunities to students as well as capabilities to prospective employers. Likewise industry can use the same model to determine which program produce graduates with the capabilities they need. If such a model existed and was accepted by academia and industry, then MSU would be better equipped to plan future directions for the TSM program.

Where is the TSM program going? Like the parents in the front seat who sometimes need a map, academic programs need an accreditation model to measure their programs' position and progress. Without a telecommunication accreditation model, TSM's argument that its program is one of "distinction" is subjective at best. It is our position that academia needs tools such as Reichgelt et al.'s(2004) methodology using seven categories and semester hours or Anthony's (2003) methodology, using three areas and credits to provide empirical support of differences in accreditation models. Such tools would support determining empirical differences for positioning computing disciplines in a model such as Anthony's (2003) CPAM. Both Reichgelt et al. and Anthony agree their research is just a start in this area of providing an empirical basis for differentiating technology disciplines.

Conclusion

Our 'road trip' of writing this paper began when we asked ourselves if we could definitively state whether or not we had created a 'program of distinction' with our TSM program that provides a distinct value to the student and industry and differentiates it from other computing disciplines, especially IS and IT. Initially looking internally, we identified that there were three related tasks. First, we needed to be able to quantitatively compare our program to other IT related curriculums. Secondly, we needed to quantitatively compare our program to other Telecommunications and networking focused curriculum. Finally, we needed to be able to articulate the 'distinction' that we found in our program to both recruit the best and brightest potential students, and communicate the high value of our graduates to their prospective employers. In order for this articulation and communication to be effective and convincing, we require metrics to support our argument.

What we found when we looked externally, was that academia at large has not adequately addressed this topic. There is no obvious or complete methodology available that allowed us to plug in the characteristics of our program and produce an analysis that plotted our position in relationship to other IT related curriculum. Good solid research has been conducted and published, but it is still clearly a work in progress with models and methodologies that are open to debate and improvement. Further, while there is plenty of anecdotal evidence suggesting that the 'network' (AKA The Internet) may now be the center of the EE/CS/IT academic and research universe, with many new and rapidly evolving telecommunications and network centric curriculums, we are still a long way from having a well defined and universally acceptable model for these programs that would allow us to evaluate their fit, form, 'goodness' and distinctiveness. Finally, MSU's requirement to articulate the value of its program to recruit students and line up employers is far from unique, so we can assume that further work in these areas would be of great value to the academic community at large.

Clearly, more research and discussion is needed. While Reichgelt et al.'s (2004) methodology of counting course content in knowledge areas is solid the validity of the chi-square analysis is suspect as it shows no significant differences between information systems and information technology programs, and surprisingly, using the Anthony (2003) methodology and data, no significant difference was observed between information technology and computer science programs. These are programs with established accreditation models that are accepted as being different and distinct in academia and industry. Both Reichgelt et al.'s (2004) and Anthony (2003) identify additional research needed to improve their models.

Are we there yet? No, and as in many IT projects, there may never be a single, clear end point to this trip. However, we are making progress on several fronts and with Reichgelt et al.'s (2004) and Anthony (2003) models, we have a start on the research required to develop tools that will provide some of the answers we need. Our original task to assess and articulate the distinctiveness and value of our program remains unchanged. This may be a very difficult task to accomplish without the eventual establishment of a Telecommunications accreditation model. Even if such a model existed, MSU might find that it can not objectively support that the TSM program is distinctive and of high value, but it would significantly help MSU lay out a strategy to make necessary changes. Finally, categorization tools and an accreditation model would allow MSU, and any academic institution, to clearly and objectively articulate to students and industry not only a program's level of distinctiveness, but also identify the critical competencies that make the program's graduates especially valuable to prospective employers.

Recommendation

As a result of our literature review and use of the methodologies described above, we make the following recommendation for future research. The Reichgelt et al. (2004) and Anthony (2003) methodologies could be modified to quantitatively categorize and position programs on a graph as depicted in Figure 6 where the measure of program content, considering *theory* versus *application* would provide an x-axis coordinate. Likewise, the examination of program content contrasting *technology* versus *business/management* content would provide a y axis coordinate. When this methodology is applied to accredited program models such as IS, IT and CS, three distinct sets of coordinates should be evident. For example, if the range of theory to application is 0 to n and the range of technology to business/management is also 0 to n then the proposed modified CPAM would model the quantitative distinctiveness of the programs and position them in a manner similar to what is seen in Figure 6. With such a model, MSU and the academic community at large could quantitatively address two of the tasks described above. First, objective comparisons of new programs such as TSM to other IT related curriculums could be made. Second, the articulation of the relative 'distinction' of a program to students and employers could be objectively supported and graphically represented.

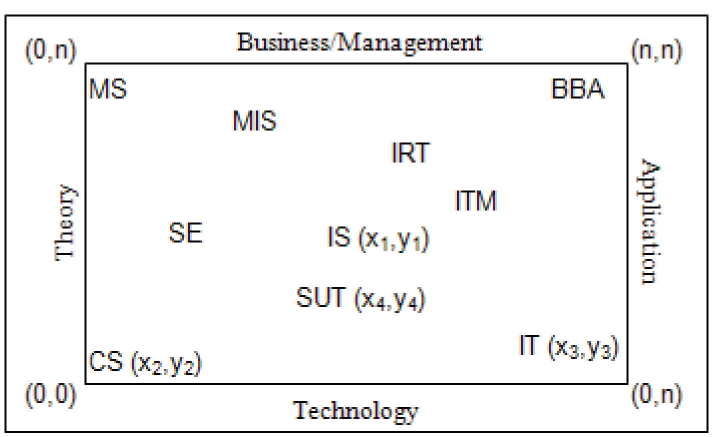

Figure 6 Proposed CPAM

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Biographies

George Rice holds degrees in Mathematics from the University of Kentucky, Lexington, KY and in Computer Science from Old Dominion University, Norfolk, VA. He joined Murray State University in 1999 as a Visiting Assistant Professor after extensive information technology project and program management experience with Unisys Corporation where his projects developed large custom IT solutions for customers including the U.S. Federal Government, N.A.T.O., and Ameritech. He has been active in keeping the Telecommunication Systems Management curriculum current.

Michael Bowman is an Assistant Professor of Telecommunications System Management at Murray State University where he teaches graduate and undergraduate courses in Telecommunications, Information Assurance, and Computer Science. He earned a PhD in Information Technology from George Mason University in 2002. Dr. Bowman served in the U.S. Army for over 26 years and retired in 2005 at the rank of Colonel. He was an instructor in computer science at the U.S. Military Academy at West Point 1990-1992. His fields of expertise include cyber security, communication systems and networking, artificial intelligence, knowledge engineering, military sensors, and military command-control (C2) systems.