

ALIGNING THE INFORMATION SYSTEMS CURRICULUM WITH THE NEEDS OF INDUSTRY AND GRADUATES

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ABSTRACT

Graduates of an undergraduate information systems (IS) program were surveyed to determine whether the curriculum could be better aligned with their career needs by adjusting the balance between technical and business content. A survey was designed and validated to measure managerial, technical, and interpersonal communication responsibilities as well as duration of employment and preference for certification requirements. A research model is presented, and path analysis is used to reduce overspecification and arrive at a parsimonious model. It was found that although emphasizing technical topics at the expense of business content may provide short-term benefits in transitioning to the work force, such a move may inhibit career advancement as graduates assume greater managerial responsibilities. Emphasizing communications and teamwork skills while maintaining the existing curriculum balance between business and technical content is indicated as an appropriate strategy to align the IS curriculum with the needs of industry.

Keywords: IS education, IS curriculum assessment, technical skills, business skills, certifications, human-resource needs.

1. INTRODUCTION AND RESEARCH QUESTION

Business schools in the U.S. have seen sharp drops in enrollment in information systems (IS) degree programs — especially when compared to peak levels during the period of rapid growth in Web-based commerce (i.e., the dotcom years). In our department at San Diego State University (SDSU), for example, the number of undergraduates declaring a major in IS in 2006 was about 30 percent of the number in 2000. The phenomenon is not unique to our department, university, or region. Similar numbers have been reported by other universities, and in related programs such as computer science and electrical engineering [8; 10]. There has been a consequent reduction in demand for IS faculty, as departments are forced to scale back their course offerings for lack of students to fill the available seats [9]. These trends raise questions as to whether employers will be able to find sufficient numbers of well-trained candidates to fill IS positions in future years.

Ours is a large, public university in the U.S., and our program is probably typical of those at many other institutions. We are mindful that if freshmen and sophomores observe IS graduates moving into good careers, they will be more likely to consider de-

claring the IS major for themselves. Other things equal, we would consider making curriculum changes that would benefit students' careers — and their future employers — by helping them either to find a first job or to advance their positions over time. We have undertaken research to inform this ongoing process of curriculum evaluation and assessment. This paper summarizes our findings, and discusses the implications for our main research question:

Would our IS curriculum be better aligned with the needs of our graduates and their employers if we increased our emphasis on technical, rather than business, content?

The argument in favor of shifting the curriculum toward the technical side is that we could give our graduates skills that better match the entry-level job requirements in the IT field, such as those that are described in advertisements and online employment marketplaces. In typical postings, there is mention of specific operating systems, programming languages, and networking protocols. Often, there is mention of industry-recognized certifications intended to demonstrate technical mastery (such as A+, MCSE, CCNA, and the like). If we emphasized technical topics, enabling — or, perhaps, even requiring — students to obtain corresponding industry certifications, we might give our new graduates an advantage in the entry-level job market.

But, would it serve the long-term interests of our students and the industries that employ them to make such an adjustment? The question of whether to move toward a more technical emphasis cannot be answered unless we are in a position to weigh the tradeoff between long-term and short-term value. We should not view the issue myopically, but with a full understanding of the value profile — over time and career — of the technical and business aspects. This research is exploratory, seeking to fill in our knowledge of how that value profile unfolds, so that we can develop an appropriate and well-considered response to the enrollment trends facing our discipline.

2. RESEARCH APPROACH

2.1 Model

To explore the research question, we studied the perceptions of graduates of our undergraduate program, which leads to a Bachelor of Science in Business Administration with major in Information Systems. This group is unique in that they possess knowledge of both our specific curriculum and current conditions in the exact industry and government sectors that frequently employ our graduates.¹ Figure 1 illustrates two processes that contribute to the formation of perceptions among graduates of our program. Undergraduate students undergo the first process

1. Other groups, such as current students, organizational recruiters, or industry managers typically have in-depth knowledge of either the curriculum or the needs of specific industry sectors, but not both. (And, the job-market sectors they are familiar with may or may not be those that most often hire our IS majors.)

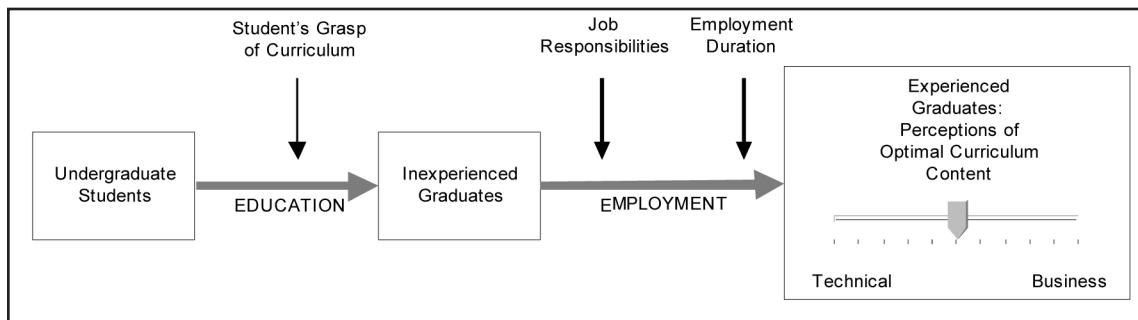


Figure 1. Research model

Table 1. Technical vs. business curriculum content

Technical content examples	Business content examples
Application development <ul style="list-style-type: none"> • programming • algorithmic design • client-server software development Internet systems architecture and development <ul style="list-style-type: none"> • web page development • web architecture design • multi-tier architecture design Database design and administration <ul style="list-style-type: none"> • construction, schema tools • triggers, stored procedures, audit controls • administration, security Systems infrastructure and integration <ul style="list-style-type: none"> • hardware • networking • systems software • systems configuration and operation 	Strategic utilization of information technology and systems IS planning IT and organizational systems Systems analysis Logical and physical design Testing Deployment Use of IT Customer service Project Management
Note: Adapted from Gorgone et al. [2003]	

when they advance through the curriculum and obtain their BS degrees. This *education* process leads to a pool of inexperienced graduates, who then enter the job market and undergo the second process: *employment*.

Dependent variable

The dependent construct in our research model is the perceptions of experienced graduates as to what should be emphasized in the IS curriculum. In Figure 1, we show the adjustments that can be made to the IS curriculum as a preference for emphasizing either technical or business-oriented content (we depict this as a slider control). Tersely, the business content covers *what* an information system should do; while the technically oriented content covers *how* to create a system that will do it. At the course level, examples of technical content are courses that impart skills in specific implementations of computer or communications technologies (see Table 1, which is adapted from the model curriculum suggested by the AIS and ACM [11]). Business-oriented content focuses on the environments in which information systems will be deployed, and emphasizes skills in analyzing business needs and mapping them onto systems, software, and network architectures. Within every IS course, there typically is coverage of both technical and business issues, regardless of the course's primary

classification, and the option usually exists to shift the emphasis one way or the other.

We have chosen to simplify the curriculum-adjustment possibilities along a one-dimensional technical vs. business axis in order to capture the essence of an ongoing discussion among academics — and to do so in a way that will lead to testable hypotheses. The discussion is whether we could better serve our students within the IS major by sliding the control to the left or the right; that is, shading our curriculum — by some amount — to make it either more technically oriented or more business oriented. By using the slider-control analogy, we mean to convey the idea of changing the content emphasis within an existing curriculum design.

The perceptions of former students who have experienced both the IS curriculum and the requirements of the job market will be particularly informative for this discussion. If moving the control to the left or right would indeed be beneficial to our graduates, we will expect to find evidence of that perception in their responses to our survey.

Independent variables

In Figure 1, we present three constructs that moderate perceptions among experienced graduates. The job responsibilities

facing IS graduates affect their perceptions of what is necessary and important in the IS curriculum; for example, graduates might believe the parts of the curriculum that have been helpful to them in their own employment should be emphasized over things that have been less useful. Therefore, we show the job responsibilities of experienced graduates as a moderator of perceptions. Also, the length of time that a graduate has been in the workforce may be correlated with a greater diversity of on-the-job experiences, a more senior position in an organizational hierarchy, or other unmeasured factors that contribute to perceptions of what is important in the IS curriculum. Therefore, we show time in the workforce as a second moderator.

We also identify in Figure 1 a moderator associated with the education process: the extent to which a student actually masters the curriculum. Students who graduate with a thorough understanding of the material will be expected to experience different outcomes in employment — and, therefore, in perceptions — than students who do not. Moreover, our research aim is not to assess the absolute impact of learning our curriculum on graduates' success outcomes, but to learn how the relative value of learning the technical and business aspects unfolds with career progress and time. The starting point for the profile is graduation, and the grasp-of-curriculum moderator will enable us to identify an information-rich sampling frame of students who graduate with a good understanding of the technical and business topics in the existing course mix.

2.1 Literature review

It is clear from Cale, et al. [4] that concern over the cyclical nature of enrollment figures for undergraduates in computer-related majors is not new. In 1991, according to Cale, et al., a force that seemed to be driving a previous decline in IS degrees was the leveraged buyouts and stock-market surge in the late 1980s, which drove students toward financial careers. George, et al. [10] support the idea that enrollment fluctuations are tied to job opportunities for graduates. They estimate that there are now 25-to-75 percent reductions in enrollments in IS academic programs throughout the world, and that enrollments now may be about what they were in 1995 or 1996. (Our own data from SDSU is comparable on this measure).

IS academics most commonly perceive themselves as preparing students for careers as systems analysts [12]. The AIS/ACM model curriculum [11] probably comes closest to encapsulating the consensus. The exit characteristics of IS graduates are categorized as business fundamentals, analytical and critical thinking, interpersonal, communication and team skills, and technology. IS is positioned at the intersection of these sets, and is characterized as “technology-enabled business development.” In this paper, we adapt the technology-business dichotomy in our research model.

Other researchers have sought to assess the extent to which IS curricula are satisfying the needs of industry [1; 5; 18]. Collaborative industry-academic curriculum design efforts have also been undertaken, as reported, for example, by Srinivasan et al [17]. In general, there appears to be a consensus in the literature that IS academics need to look to industry for guidance as to what should be taught to IS undergraduates. Lee et al. [13] concluded — after surveying IS managers, IS consultants, and end-user managers — that the three important dimensions of an IS education are technology, management and interpersonal

skills. We have adapted this basic skills typology for use in this paper.

In our research model, we simultaneously account for the three moderators shown in Figure 1, and develop testable hypotheses. We have found no other papers that control for the students' grasp of curriculum, job responsibilities, and time in the workforce in the formation of perceptions. Our contribution to the literature results from our ability to use these moderators to understand how perceptions are formed over time, and, therefore, to enable us to more fully appreciate the long-term impact of curriculum-design choices we may make.

3. SURVEY INSTRUMENT

3.1 Sampling Frame

In order to explore how the value profile of learning the technical and business curriculum content unfolds over time and with career progress, we need a sampling frame consisting of graduates who start their careers with a good understanding of the curriculum as it stands. Our sampling technique is that of the homogeneous, purposeful sample, which is appropriate when we require sampling units that are information-rich and informatory [14]. Our purpose is not to generalize our findings to the larger population of all graduates, but to explore in detail the phenomena of interest represented by Figure 1. For this purpose, we need sampling units who are homogenous with respect to the grasp-of-curriculum moderator. Moreover, we added the further restriction of limiting our sample to IS graduates who received their degrees in the last ten years, because these alumni experienced a curriculum that is roughly in the same balance between technical and business content as the one in place today.

Our department has invested in maintaining an Alumni Advisory Board, with a membership that includes some of our top graduates over the past ten years [15]. The purpose of the board is precisely to help us gain insights into curriculum-development issues of this sort (as well as participate as guest lecturers and assist with hiring and recruiting of our graduates). The group meets our criteria for the sampling frame, and was therefore used as a homogeneous sample of experienced graduates with a good understanding of the IS curriculum.

The survey was sent to all 182 Alumni Advisory Board members and was followed by an email reminder a few weeks later. Responses arrived and were tabulated during the subsequent four months. Of the surveys initially sent out, twenty-five were returned as invalid mailing addresses, resulting in a base of 157 possible responses. Eighty-one surveys were returned for a response rate of $81/157 = 51.6$ percent.

3.2 Operationalization of constructs

Independent variables

Employment duration. To operationalize the employment-duration moderator within our survey instrument, we distinguished between (1) lifetime work experience and (2) work experience since completing an undergraduate education in information systems.² The first item acknowledges all of the work experience of the respondent and the second was used to operationalize the employment-duration moderator for this

Table 2. Demographic and work information for the 81 alumni advisory board respondents

Mean Age (std. dev.): 32.88 (8.08)			
Mean Work Experience since Graduation (std. dev.): 4.95 (3.20)			
Mean lifetime Work Experience (std. dev.): 9.71 (8.58)			
Sex: 50 Males, 28 Females, 3 no-response			
Currently Working? 74 Yes (57 in IS Field, 17 in non-IS Field), 7 No			
Size of Organization:		Location:	
less-than-25 employees:	11 (14.9%)	San Diego County:	54 (66.7%)
26-to100 employees:	9 (12.2%)	Southern California:	10 (12.3%)
101-to-500 employees:	13 (17.6%)	Northern California:	6 (7.4%)
over-500 employees:	41 (55.4%)	In the U.S. but not California:	8 (9.9%)
		Outside of the US:	3 (3.7%)

Table 3. Factor analysis and Cronbach's α for items measuring managerial and communication responsibilities

Item	Factor 1	Factor 2	Cronbach's α
M1: I help our organization succeed by making use of my knowledge about the key success factors that must go right.	0.588	0.217	
M2: I help ensure that my organization's investments are long-term and consistent.	0.696	0.089	
M3: I help make sure that the strategies of my own group and the organization as a whole are well aligned.	0.699	0.178	0.830
M4: I am responsible for managing other employees	0.592	0.152	
M5: I am responsible for setting and meeting a budget.	0.635	0.222	
M6: I plan, organize, and lead projects.	0.608	0.408	
C1: I make presentations to groups of people.	0.359	0.604	
C2: I work in a cross-functional team.	0.084	0.906	0.757
C3: I work cooperatively in a team environment.	0.186	0.563	

Notes: Factor analysis used Varimax rotation. Eigenvalues: 2.61, 1.83. Boldface indicates the heaviest factor loading for an item. Items M1-M6 were used to measure managerial responsibilities and items C1-C3 were used to measure communication/teamwork responsibilities. All items were measured on the following scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

study. Table 2 contains descriptive statistics summarizing these measures of employment duration within the sample as well additional demographic and work related information.

Job responsibilities. To choose a suitable framework for operationalizing the job-responsibilities moderator, we began with the results of Lee et al. [13]. They surveyed IS industry managers and consultants to determine the kinds of knowledge and skills required of IS workers. They reported four main categories: knowledge of technical specialties, technology management skills, business functional knowledge, and interpersonal skills. To operationalize the job-responsibilities construct, we focused on two categories of responsibilities: management re-

sponsibilities and interpersonal-communications responsibilities. We adapted scales used by Byrd and Turner [3], who investigated the relationship between IS skills and success factors for an enterprise. For our purposes, the Byrd and Turner items required rewording to make them fit the context. That is, we surveyed individuals about their own job responsibilities, whereas Byrd and Turner surveyed CIOs about the responsibilities of employees in their enterprises.

Table 3 shows the items that were included in the survey instrument, and gives the results of a test for convergent and divergent validity. We had initially used five items for the communication responsibilities construct. However, two of them loaded poorly with the other items and were subsequently removed from the analysis. The results of principle factor analysis support a two-factor model in which all items that measure the same construct load heavily on a single factor and no items load heavily on a construct they were not intended to measure. The Cronbach's Coefficient [6] statistics indicated reasonable inter-item reliability for the scale of each construct (Table 3). For the purposes of hypothesis testing (see Section 4), the average of the six managerial items was used to represent the managerial

2. This is important for SDSU graduates in particular, because many of our students are non-traditional: They may not begin their undergraduate studies at the age of eighteen, but may first complete some years of non-professional work in the public or private sector and then pursue their higher education at a later stage in their lives.

responsibility construct, and the average of the three communication items was used to represent the interpersonal communications responsibility construct.

Although Lee et al. [13] and Byrd and Turner [3] include technical work responsibilities in their typologies, measuring these in our survey proved to be difficult. Technical responsibility is a higher-order construct that does not lend itself to direct measurement at the individual-employee level. We used the following one-item measures for seven distinct instances of technical work:

- I am responsible for the installation of software for users.
- I am responsible for providing technical support to users.
- I am responsible for establishing network connectivity for users.
- I am responsible for troubleshooting hardware problems for users.
- I am responsible for writing database queries.
- I am responsible for developing web-based applications.
- I am responsible for writing computer programs.

These items were measured on a 5-point Likert scale (Strongly Disagree = 1 to Strongly Agree = 5).

Dependent variable

Our research model has a single dependent variable: perceptions of experienced graduates as to the appropriate balance between technical and business orientations in the curriculum. To operationalize it, we asked respondents: "Should the IS major at SDSU require students to achieve specific industry certifications?" By asking about certifications, we forced respondents to think about what students would gain from learning the technical details needed to pass the certification exam. And, by asking whether the certification should be required rather than merely optional, we also forced them to consider that adding additional technical content to the required curriculum would subtract from the time available to teach business-oriented subjects. Thus, respondents answering "yes" can be said to favor moving the curriculum somewhat away from a business orientation, and toward a technical emphasis.

Among the thirty-one respondents who answered "yes" (38.3 percent), six did not recommend any specific certifications and the remaining twenty-five recommended an average of 2.4 certifications, with no clear consensus as to which would be most valuable.

4. MODEL VERIFICATION

4.1 Propositions

By selecting a homogeneous, purposeful sample of alumni, we constrained the variability of the grasp-of-curriculum moderator shown in Figure 1. The other two moderators, however, have expected interactions with each other and with the perceptions of the sampled graduates. Before we interpret our survey results, we want to verify that our presumptions about how these interactions operate are borne out in our data. We arrived at the following propositions, which capture our ex ante expectations of how the

moderators given in Figure 1 influence the perceptions of experienced graduates.

The thrust of Propositions 1-3 is that an undergraduate business-school education with an IS emphasis will prepare students for management-level career paths. In a broad sense, these three propositions capture what we would *like* to be true about our impact as professors in an undergraduate IS program.

Proposition 1: *The longer graduates have been in the workforce, the more managerial responsibilities they will tend to have.* As a corollary, we would expect that *the longer graduates have been in the workforce, the fewer technical job responsibilities they will tend to have.* Proposition 1 reflects our expectation that IS workers often begin their careers doing highly technical tasks, but then move into managerial or leadership roles over time.

Proposition 2: *The longer graduates have been in the workforce, the more their jobs will involve interpersonal communications.* Proposition 2 arises from our expectation that entry-level workers are often given well-defined tasks to accomplish, which can be completed in relative isolation from other workers. As employees gain more responsibility for planning, analysis or design, their output will increasingly tend to take the form of oral or written communications, rather than operational work products.

Proposition 3: *The more managerial responsibilities graduates have, the more interpersonal communications skills their jobs will require.* This proposition states that managerial and interpersonal responsibilities covary, rather than vary independently. In other words, jobs that involve managerial responsibilities will tend also to have significant communications requirements.

Propositions 4-6 propose that the increased managerial and communications responsibilities attendant on career maturity lead experienced graduates to recognize the value of the business-oriented parts of the curriculum. If support is found for these propositions, it will be an indication that business skills learned in college are enablers of career progress.

Proposition 4. *The more managerial responsibilities experienced graduates have, the less value they will place on the technically oriented parts of the IS curriculum.* This proposition follows from an expectation that graduates will place the most value on parts of the curriculum that are immediately useful to them, and that the technical aspects of the curriculum are less relevant to managerial workers. This is not to say, however, that technical skills are not valued by managerial workers. Rather, we acknowledge that the skill set of managerial workers is multi-dimensional and so technical skills are less relevant relative only to the mix of skills required to do their jobs.

Proposition 5. *The more interpersonal communications responsibilities graduates have, the less value they will place on the technically oriented parts of the IS curriculum.* We expect that interpersonal communications responsibilities arise most prominently for workers who do such tasks as analysis, design, planning, business development and project management – tasks that are supported primarily by the business oriented aspects of the curriculum.

Proposition 6. *The longer graduates have been in the workforce, the less value they will place on the technically oriented parts of the IS curriculum.* This proposition follows logically from Propositions 1-5. As managerial and communications responsibilities increase over time, graduates will come to place higher value on the business-oriented parts of the curriculum, and lower value on the technically oriented parts.

Table 4. Hypothesis for testing Propositions 1 to 6 and results

<i>Hypothesis</i>	<i>Correlation</i>
H1: Work experience since graduation is positively correlated with managerial responsibility.	0.358**
H2: Work experience since graduation is positively correlated with communication responsibility.	0.204*
H3: Managerial responsibility is positively correlated with communication responsibility.	0.457***
H4: Managerial responsibility is negatively correlated with preference for certification requirement.	-0.244*
H5: Communication responsibility is negatively correlated with preference for certification requirement.	-0.251*
H6: Work experience since graduation is negatively correlated with preference for certification requirement.	-0.308**
H1a: Work experience since graduation is negatively correlated with technical work responsibility.	
I am responsible for the installation of software for users.	-0.287**
I am responsible for providing technical support to users.	-0.021
I am responsible for establishing network connectivity for users.	-0.353**
I am responsible for troubleshooting hardware problems for users.	-0.498***
I am responsible for writing database queries.	0.063
I am responsible for developing web-based applications.	-0.103
I am responsible for writing computer programs.	0.175

Notes: one-tailed p-values for correlations: *p < 0.05, **p < 0.01, ***p < 0.001

The technical work responsibility items used to test H1a were measured on the following scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. Preference for technical certification was coded as Yes=1 and No = 0

4.2 Tests of hypotheses

Table 4 lists the hypotheses that we tested using correlation coefficients between measures derived from the survey.

Hypotheses 1-3 (corresponding to Propositions 1-3) represent the interactions between the employment-duration and job-responsibilities moderators from Figure 1. To test Proposition 1 we hypothesized that work experience since graduation would positively correlate with managerial responsibility (H1). This correlation was significant ($r = .358$, p -value < .01) and thus offers support for Proposition 1 (Table 4). To test Proposition 2 we hypothesized that work experience since graduation would positively correlate with communication responsibility (H2). This correlation was significant ($r = .204$, p -value < .05) and thus offers support for Proposition 2 (Table 4). To test Proposition 3 we hypothesized that managerial work responsibility would positively correlate with communication work responsibility (H3). This correlation was significant ($r = .457$, p -value < .001) and thus offers support for Proposition 3 (Table 4). The support for Propositions 1 to 3 suggests that increased managerial and interpersonal job responsibilities tend to be related: career progress leads to demand for our graduates simultaneously to demonstrate mastery of business and communications skills.

To provide additional confirmation of Proposition 1, Table 4 summarizes the correlations between work experience since graduation and the aforementioned seven scales that were adapted from Byrd and Turner [3] to operationalize technical work responsibilities (we have numbered these tests jointly as H1a). Three of the items had significant negative correlations with work experience since graduation and all three refer to highly technical tasks: software installation ($r = -.287$, p -value < .01), network connectivity ($r = -.353$, p -value < .01), and hardware troubleshooting ($r = -.498$, p -value < .001). Evidently, graduates who do such tasks in entry-level jobs tend to move on to different responsibilities over time. Collectively, support for Propositions 1-3 confirms

that our IS program graduates are having success in launching themselves into the kinds of career paths we anticipate for business-school students.

We turn next toward evaluating Propositions 4-6, which will tell us whether graduates perceive the business-related content of the curriculum to be increasingly valuable as they mature in their careers. Hypotheses 4-6 (corresponding to Propositions 4-6) represent the interactions between job-responsibilities and perceptions of technically related content (Figure 1). As noted above, a recommendation for technical certification requirements operationalizes a perception that technical content should be increased in the IS curriculum at the expense of business content. To test Proposition 4 we hypothesized that managerial work responsibility would negatively correlate with technical certification requirement (H4). This correlation was significant ($r = -.308$, p -value < .01) and thus offers support for Proposition 4 (Table 4). To test Proposition 5 we hypothesized that communication work responsibility would negatively correlate with technical certification requirement (H5). This correlation was significant ($r = -.251$, p -value < .05) and thus offers support for Proposition 5 (Table 4). To test Proposition 6 we hypothesized that work experience since graduation would negatively correlate with preference for a technical certification requirement (H6). This correlation was significant ($r = .308$, p -value < .01) and thus offered support for Proposition 6 (Table 4).

The support for Propositions 4-6 adds to our understanding of how the IS curriculum interacts with the careers of experienced graduates. Not only do they move into jobs with increasing managerial and communications responsibilities over time, but they tend increasingly to value what our undergraduates are taught about business-oriented topics. This is preliminary evidence that the IS program is well aligned with its mission objectives, because it suggests a causal relationship between the learning of business skills in college and the attainment of a business or managerially oriented career.

4.3 PATH ANALYSIS

The six propositions form a structure that overspecifies correlations between our theoretical constructs, in the sense that both direct and mediated effects are included. Having validated the propositions individually with simple linear regression (in the form of a correlation coefficient), we next proceed to test them collectively using path analysis. Path analysis uses serial multiple regression and provides an analysis of direct and indirect effects as well as the opportunity for theory trimming [7], in which non-significant paths are eliminated and a hypothesis test is conducted to determine whether the reduction in paths reduces the fit of the model.

A path diagram is presented in Figure 3 showing the six interrelated hypotheses. The model contains one exogenous variable, years work experience since graduation (WrkExp), and three endogenous variables, namely, managerial responsibility (MGMT), communication responsibility (COMM), and preference for certification requirement (CERT). A path analysis requires a common data set for all paths; thus, observations with a non-response to the certification preference item were eliminated from the analysis, even if participants completed the questionnaire for all other items. Standardized beta coefficients are presented for each path and the error estimate (representing all other sources of variability, including measurement error) for endogenous variables. Statistically significant coefficients are indicated with a solid line and non-significant paths are indicated with a dashed line.

There are four significant effects in the model, including three direct effects (WrkExp_MGMT, MGMT_COMM, WrkExp_CERT) corresponding to hypotheses one, three, and six respectively, and one indirect effect (WrkExp_MGMT_CERT). It is notable that three of the significant correlations presented above for hypotheses two (WrkExp_COMM), four (MGMT_CERT) and five (COMM_CERT) were not significant when included collectively with the other hypothesized relationships.

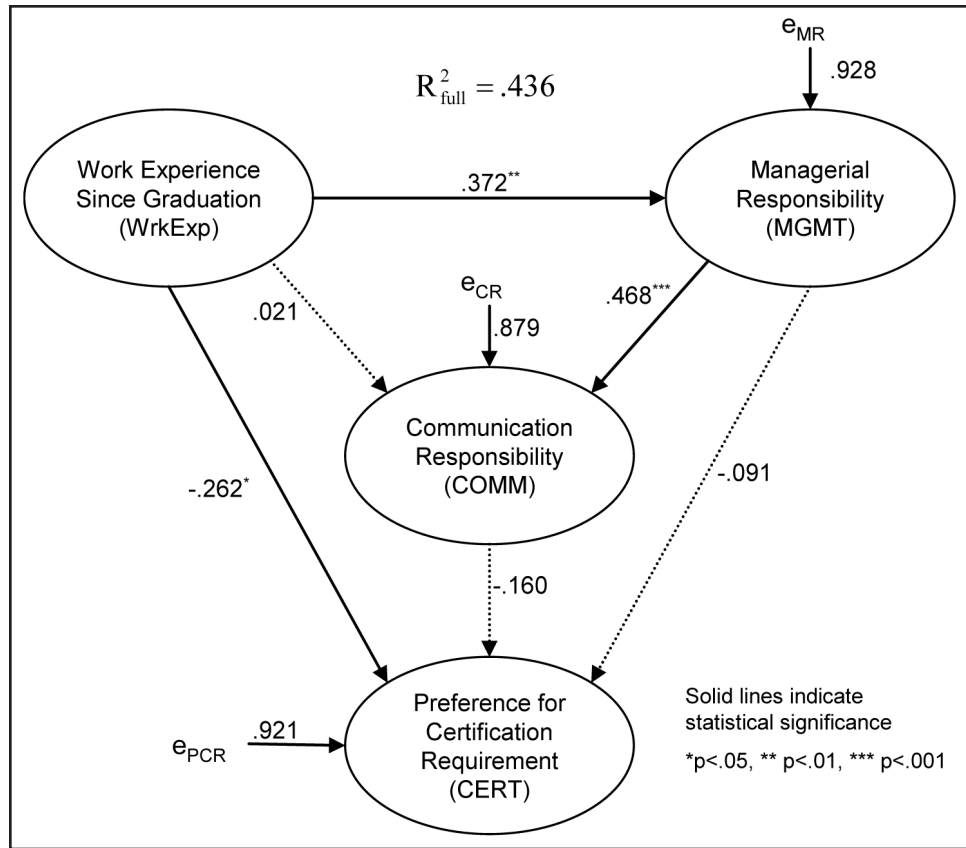


Figure 3. Path Analysis Diagram (full model) testing all six a priori hypothesized regression paths

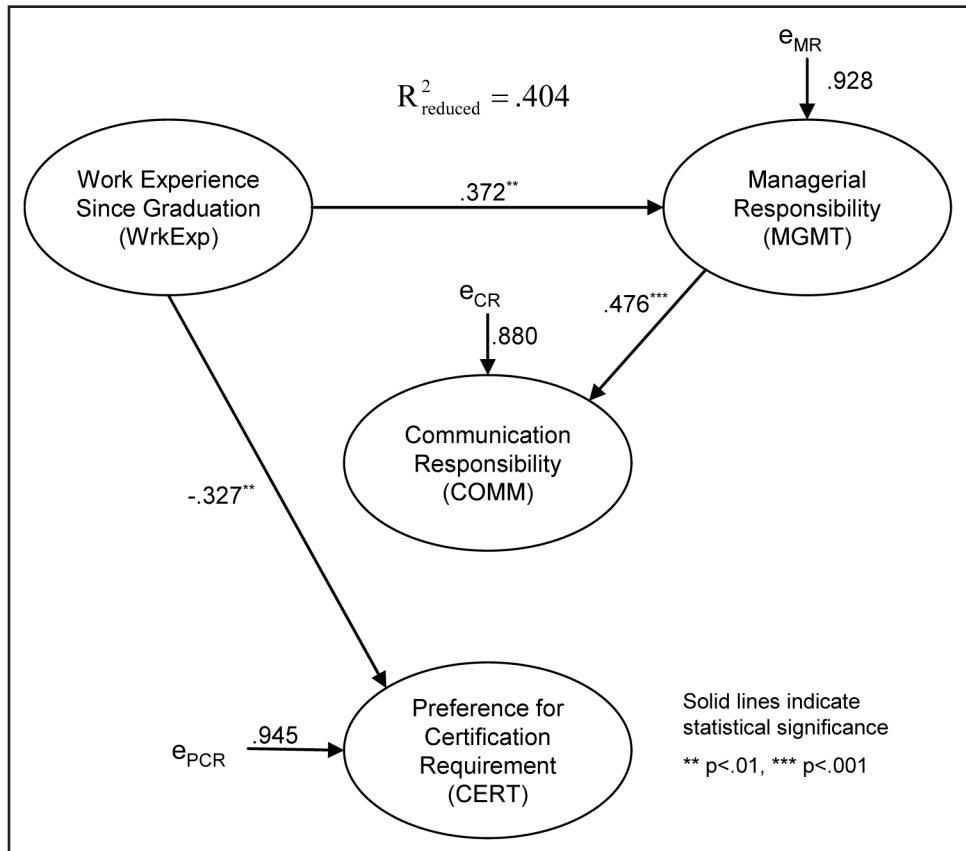


Figure 4. Path Analysis Diagram (reduced model) with non-significant regression paths deleted

The three non-significant paths were subsequently deleted from the model and the resulting reduced model (Figure 4) was examined to determine if it fit the data as well as the full model. For this analysis, the full model (Figure 3) has the qualities of a just-identified model in that it contains paths between each pair of variables and thus provides a basis for evaluating the reduced model [7]. The resulting Q statistic of .948 exceeded the recommended threshold of .90 [2] necessary to conclude an adequate fit of the reduced model. Further, the chi-square test comparing the models was non-significant ($\chi^2 = 3.22$, $df = 3$, $p = .359$), indicating that the reduced model fits the data as well as the full model. The result is a more parsimonious model of the data.

5. ANALYSIS AND DISCUSSION

Based on the path analysis and the corresponding support found for Propositions 1, 3 and 6 in our survey, we reach two main conclusions:

1. Graduates of our undergraduate IS program tend to move into jobs with more managerial responsibilities over time, and these positions require both business and interpersonal communications skills.
2. As the graduates mature in their careers, they increasingly tend to value the business content and are more likely to perceive that the technical aspects of the undergraduate curriculum should not be increased at the expense of the business content.

The second of these conclusions is strongly suggestive that experienced graduates think there is a causal relationship between what they learned in the IS curriculum about business and managerial skills and their ability to sustain their careers. If they felt otherwise — that what they learned is not important to their career progress — it would be implausible for them to resist recommending a reduction of the business content in favor of increased technical content.

One challenge in designing the IS curriculum is determining what technical skills should be taught in the IS major. Certifications typically focus on a particular technology, technical process, or language, and by their nature represent a deep rather than broad approach to technical training. Our graduates who learned the material well when they were students seem to be telling us that it is the business parts of the curriculum that have helped them sustain successful careers.

We expected to gain insight from our survey as to whether we might better serve our graduates by shading our IS program toward either a technical or a business emphasis. Our conclusion, now that we have quantitatively assessed the way that curriculum value unfolds over time, is that we should not reduce the business focus. We recognize the possibility that our students' short-term task of transitioning from the university to the work force might be made easier if they have specific technical skills that match an employer's current openings. But, we can see from Hypothesis H1 in Table 4 that there is a strong negative correlation between work experience and early-career technical activities, such as those that are the main subjects of certification programs. Thus, if we were to shift the emphasis toward the technical side, we would run the risk of impairing our students' ability to move into the kinds of management-related career paths that we associate with and expect of business-school graduates.

Another implication of our study is that communication and

teamwork skills occur prominently in the perceptions of experienced graduates of our program. This finding suggests ways that we can be proactive about improving our teaching methods to better prepare students for the workplace. A renewed emphasis on group projects, presentations, and written communications skills throughout the curriculum — in addition to continuing to require students to complete a formal course of instruction in business communication — might be the most important set of actions we can take to help our graduates obtain jobs and advance in their careers. Clearly, it is not enough to train students in the managerial and technological aspects of the IS field. We must also produce graduates who can *articulate* their knowledge [16].

There are limitations that may reduce the degree to which our findings can be generalized. The scope of the research was a specific curriculum for graduates working predominantly in Southern California, and the results may differ for graduates of other universities with their own unique curricula — or even for similar students and curricula in other regions of the country with different economies and industries. Even in the context of SDSU's program and the Southern California economy, we recognize that the IS field is continually changing. Thus, the views of our experienced graduates may change over time, and the research presented here should be repeated periodically as part of the ongoing assessment process.

A final limitation is that our study was designed to explore the relative value profile, over time and career, of successfully learning the material that our present curriculum is intended to convey. We did not develop measures, in this research, that would allow us to gauge the absolute value of the curriculum at any one point in time or for specific industry positions; nor does our study illuminate the extent to which graduates with a good grasp of the curriculum experience career outcomes different from graduates whose understanding may be less complete.

Ongoing assessment can help ensure that we are meeting the needs of our stakeholders by determining if those needs have changed or are no longer being met by our curriculum. We argue that graduates from the preceding ten-year period are in a unique position to inform this process, because they are knowledgeable of both the curriculum and the requirements of industry. By drawing on their knowledge of the kinds of work responsibilities our graduates are likely to confront over time, we can continue to identify the skill sets that will help them sustain successful and rewarding careers. In the long run, we believe this is what will reverse current enrollment trends in IS.

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