The Role of Skills in the Development of the Undergraduate Curriculum: The Case for Double-Loop Learning in Decision-Making

Jeffry S. Babb, Jr.
jbabb@wtamu.edu
Computer Information & Decision Management,
West Texas A&M University
Canyon, TX 79119

Herbert E. Longenecker, Jr.
hlongenecker@usouthal.edu
Computer and Information Sciences, University of South Alabama
Mobile, AL 36688

Charles R. Woratschek
woratschek@rmu.edu
Computer and Information Systems, Robert Morris University
Moon Township, PA 15108

Amjad Abdullat
aabdullat@wtamu.edu
Computer Information & Decision Management,
West Texas A&M University
Canyon, TX 79119

Abstract

This paper encourages a reflective long-view of the IS undergraduate curriculum which suggests that the professional marketplace has consistently valued the same core IT skills. The conundrum faced by department chairs and curriculum committees is how to adjust to changes in the IT environment and marketplace while also fostering a core of basic IT skills which lead to a consistent tradition of IT skills for the IS discipline. We highlight Argyris and Schön's (1974, 1978, 1996) work on organizational learning as a philosophical and theoretical lens through which the curriculum decision-making process can be better understood. To wit: cycles of skills and learning assessment, which utilize key constituents to provide feedback loops for error detection and correction, both promotes and restrains the tendency to react and over-react in curricular decision-making. Towards this end, the 2010 AIS/ACM model curriculum is considered against previous model curricula in order to examine the degree to which the need for basic IT skills has actually changed. Future research directions are discussed which will facilitate inquiry into which IT skills have consistently mattered in the Information Systems discipline over the last 20 years. It is our

position that a cycle of reflective learning is needed to undertake appropriate error correction and detection in the process of curricular decision-making.

Keywords: IS Model Curriculum, Decision-Making, Reflective Learning, IT Skills, Jobs, Role of IS

1. A DISCIPLINE IN CRISIS STILL MATTERS

Nicholas Carr (2003) famously posited that "IT doesn't matter" just at a time when the wider Information Technology (IT) field was down on its luck; what with the "Dot Com Bust" and with Friedman's (2005) flattening world accelerating global labor arbitrage acutely felt amongst many IT workers. One discipline which has both benefited and chagrined from its association with IT is Information Systems (IS).

IS, often located in schools of business, has lived in the academic shadow of management and computer sciences in somewhat equal measures (Baskerville and Myers, 2002). At times, IS has uneasily existed in its business school home, depending on what cycle the wider IT industry was in, or what trend or fad was in vogue. Moreover, the Information Systems discipline has led an uneasy co-existence with its parent disciplines for most of its existence (Baskerville and Myers, 2002). As the IS discipline has profited and perished according to the boom/bust inherent to all IT disciplines, undergraduate IS programs are under ever-present pressure to adjust curriculum accordingly (Kroll et al., 2010). This pattern of adjustment to short-term trends and market effects also affects rational and long-term thinking with respect to curriculum development. Add to this various constraints on curriculum placed by accreditation requirements, and it quickly becomes evident that curriculum decision-making is fraught. It is not unique that curriculum development has its challenges, as surely other disciplines have their own struggle, rather the challenge is to design a compelling curriculum that suits the needs of students, professionals and the industry. A more fundamental question lies in whether Information Systems, as a discipline, still matters. While this is difficult to answer forthrightly, we feel that IS most certainly matters to those in the discipline and profession who rely on the fundamental knowledge and skills we impart in the IS curriculum.

This paper will explore the importance of the IS discipline in the context of decision-making for the IS curriculum in the following manner. First, we continue a discussion on the nature of the IS discipline and concomitant effects on undergraduate enrollments in the last decade. This is followed by a discussion of the role of change as an essential component of the nature of the IS discipline. Next, we focus on the persistent requirement for IT skills in the IS discipline. We follow this with a look at the IS undergraduate curriculum and how faculty learn through the delivery and assessment of this curriculum in the face of environmental changes. Lastly, we look forward towards an iterative, reflective, and unified model of the undergraduate IS curriculum.

What is IS?

First, we should review with a simple question: what is IS? Silver et al. (1995) have suggested that IS lives in a duality anchored by (1) skills-and-function-oriented areas of software, hardware, and data (the IT artifacts); and, (2) business processes and the management of data/information processing infrastructure. In-between these two realms is the constancy of people (the human and managerial factor). Thus, by its original nature, IS suffers from a schizoid incoherence (Reihlen et al., 2009) which confounds attempts to a) establish a mature and stable discipline; and b) establish an appropriate undergraduate curriculum which supports industry's skills requirements in a sustainable manner. Thus, educators are charged with preparing students for successful entry into industry and a career that is sustained by foundational knowledge broad enough to accommodate ephemeral trends. However, debate concerning the fundamental nature of the IS discipline will confound these efforts. Confusion about the nature of IS, both in terms of research and tutelage, is not particularly new (Glass et al., 2004), but it is poignantly compelling at the moment as the discipline has not fully recovered from wide-ranging setbacks and adjustments experienced in the first decade of the 21st Century.

Characteristics of the IS Graduate

To better understand the IS discipline, it is appropriate to also focus on the characteristics of the IS graduate: ideally, an IS professional

must be versed in the functional and practical aspects of IT artifacts and also be fluent in the aspects of business processes common to the realm of the analyst. However, as the IS discipline reacts to trends in the environment, curricular focus is understandably and consequently influenced – making a perfect balance elusive.

When organizations first leveraged the strategic and competitive advantage of IT in the 1970s and 1980s, the technology-management aspects of the IS discipline gained emphasis. When end-user computing took off in the 1980s and 1990s, IS-trained professionals were poised to write office automation systems and also understand business process modeling/engineering in their respective functional areas. When the Internet and the World Wide Web took hold of business, and society at large, IS professionals were able to join in the "gold rush" that was the "Dot Com" era.

Trends in the marketplace over the past decade have affected the computing professions in advanced western economies and, as a result, enrollment in programs in IS (along with those in IT and Computer Science) have contracted at schools in these affected economies. It is tempting, in the face of these realities, to make far-reaching adjustments in the IS curriculum as uncertainty regarding the future of computing disciplines persists. Thus, as we develop our curriculum strategies, the fundamental concern remains enrollments; and enrollments predicate on demand in the industry.

Where did the IS Students Go?

In light of recent developments in the IT marketplace and industry, it is tempting to pronounce the IS discipline as a dead-end. However, contrary predictions (typically from the U.S. Bureau of Labor Statistics), suggest that computing disciplines are only set to evolve and flourish. This raises another question: are our enrollment challenges cyclical or is something else afoot? Furthermore, with respect to curriculum design we ask: are the foundations of the discipline, especially concerning core skills, fundamentally obsolete, or, do we need to revitalize these skills in new contexts? Moreover, if the skills imparted in our curricula are indeed appropriate, then why have they lost attraction for college-aged and college-bound students? Lenox et al. (2008) suggest that the phenomenon of low enrollments is fundamentally structural; moreover, these structural changes should actually favor the multi-disciplinary nature of IS (i.e. technically competent professionals who can also interface between IT systems and organizational systems). What is clear is that, for the IS discipline, IT will certainly continue to matter (Orlikowski and Iacono, 2001) as a fundamental part of its raison d'être. Accordingly, we are certain that a curriculum design approach would not involve the abandonment of our core IT skills.

It is often said that crisis presents opportunity and undoubtedly some will believe that our present opportunity is to change the shape of the discipline to accommodate the future. Klawe and Shneiderman (2005) have suggested that our collective future relies on "...winning back student enrollment, public interest in technology, and government research funding (p. 27)," and this certainly rings true with respect to reigniting interest in what IS has to offer – specifically, a central focus on IT.

As we grapple with issues related to curriculum design and assessment, we must be mindful of our constituents, perhaps most of all, those whom we educate (Woratschek and Lenox, 2009). While the answer to "where did the students go?" may have many possible answers (Granger et al., 2007), the question has acute meaning for IS programs situated in schools in advanced and western economies; our students are, after all, our lifeblood. Accordingly, our curricular decision-making focus in these IS programs should be on learning and feedback cycles which allow the application of our fundamental skills and expertise in new contexts. In this sense we can approach learning as a change management strategy.

The Role of Change in the Discipline

Change is an agent for learning and growth as much as it is a disruptive force; it can be argued that IS, as a discipline, arose from the need to manage and shape information-wrought change in organizations. In this sense, the IS discipline is about facilitating the information services required to make appropriate decisions and appropriate work flow. Regularly, this goes beyond getting "...the right information to the right person at the right time..." and more profoundly extends to improving "...the performance of people in organizations through the application of informa-

tion technology." (Sprague and McNurlin, 1997)

As our discipline has and continues to experience a decline in enrollments in our academic programs, it becomes evident that the discipline has a change management problem on its hands. As the IS discipline now has this internal problem, a system of reflective self-evaluation somehow seems harder to come by. In response to this conundrum, the literature on organizational change management would likely recommend that we focus on our patterns of organizational learning (Argyris, 1977; Keen, 1981; Markus and Robey, 1988; Orlikowski, 1993; Gurbaxani and Whang, 1991). Argyris (1977) reminds us that an important facet of learning is error detection and correction. Thus, with respect to the fundamentals of our discipline, what errors are we susceptible to in the face of our current crisis and how might we detect and correct them?

The Persistence of Basic Skills

Among the gravest of errors we see possible at this juncture is the temptation to cut critical core skills as a means of student retention. We feel this is a grave error from the basic perspective of the value proposition that the discipline holds for its constituents. In this sense, we can comprehend our enrollment and curriculum decision-making problem in light of the value of our core IS skills and knowledge have for society and organizations. We can argue that our perceived value lies within the skills that an IS professional uses to disseminate, shape, and transform information:

One indication of students' strong interest in new applications is the success of information schools and information systems programs in business schools that emphasize information, Web design, information architecture, social computing, and online communities, especially in health care, education, e-business, and digital government. This success reflects the attraction of these new topics for students, as well as the strong job market for students with the related skills (Klawe and Shneiderman, 2005).

We see and acknowledge that a linkage among skills, jobs and public perception is fundamental to our decision-making. Students who enter undergraduate programs in IS are shaped by their every-day use of IT and also by societal positions on and opinions of IT. If perception exists that traditional and well-known career opportunities have shifted overseas, then what new opportunities will arise to supplant the old and where can the skills and knowledge driving these new opportunities be acquired? Or, more importantly, are these new opportunities really "new?" One danger is that IS programs will begin to chase the IT trend du jour such that long-standing traditions, knowledge, and skills fundamental to our discipline will be hastily abandoned in favor what may be fickle and short-term trends (Lightfoot, 1999). Again, a system of reflection which allows for the incorporation of new trends into the existing framework of our basic skills and knowledge is an appropriate response to this problem. Thus, we can argue that our attempts to ascertain and describe model curricula for Information Systems undergraduate programs needs continuous feedback mechanisms which allow for error detection and correction with respect to the assimilation of skills that match the job market without compromising the fundamental and essential nature of the discipline.

2. THE INFORMATION SYSTEMS UNDERGRADUATE CURRICULUM

The professional societies which surround computing - The Association for Information Systems, the Association for Information Technology Professionals, and the Association for Computing Machinery - have engaged in the task of defining the central tendencies of an undergraduate curriculum in Information Systems for over two decades now. The outcomes of these endeavors, the IS 1995, IS 1997, IS 2002 and IS 2010 model curricula, have each described the learning units fundamental to the knowledge and skills which best serve the industry and our graduates. With the implicit and explicit support of these professional societies, industry and the academy have a common vocabulary from which the discipline can flourish. While these curriculum models typically offer sound guidance, when jobs are disappearing and enrollments are down (or at least appearing so), there is a temptation to quickly mend and retool the discipline as one would do in emergency-room triage. However, we feel that a slowing of the industry and a shift due to geopolitical and market factors should not necessarily constitute the fulcrum for a fundamental change in the skills and knowledge requirements of the discipline. This leaves us with the task of reconciling what is fundamental.

Defining Essential IT Skills

There is no question that our IS programs should teach the requisite skills necessary to sustain the industry. To this end, we have studies on trends in skills requirements in industry (Table 1) which call for balance between our core traditions and the effects of new IT innovation (Landry, et al., 2000, 2003). Our concern is how we can craft appropriate reactions to changes in the environment such that we don't over-correct and inappropriately eliminate our core knowledge/skills areas.

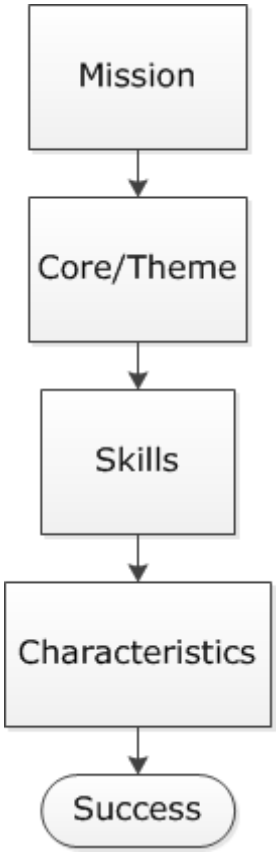
Table 1 Common Themes in Elements of Skills

Landry et al., 2003	Landry et al., 2000
Systems development tools and techniques	Software/Web Development; Database
Interpersonal skills/communication	Business Fundamentals; Individual and Team/Interpersonal skills
Systems implementation and testing strategies	Systems Integration
Systems development concepts and methodologies	Systems Analysis and Design
Approaches to systems development	Project Management

The Relationship between IT Skills and the IS Discipline

It is important to observe that previous efforts at establishing model curricula - IS 1997 (Gorgone et al., 1997) and IS2002 (Davis et al., 2002) occurred during years of relative prosperity with respect to the health of the industry in advanced, western economies. Certainly the ravages of the so-called "Dot Com Bust," circa 2000, were known by the time IS2002 was released, however, it was too close to the event at the time to know how these events would ultimately unfold. Now, eight years on, the long-term effects are well known: enrollments have not fully recovered, programs have folded, and there is little doubt that many of the traditional avenues and opportunities for our graduates have changed and/or dried up. While other new opportunities have materialized, the landscape seems different to some. As we consider these matters we must still question: will the discipline's fundamental skills be any different? While the effects of technological change on our curriculum design has been previously examined (Anderson and Tushman, 1990), each change cycle raises questions concerning what the new model will look like and what content is no longer valid. Moreover, we've experienced the boom/bust cycle in the past, and throughout these cycles, many core aspects of our dominant design have remained stalwart.

Figure 1 Relating the Discipline to Skills



Eventually, IT skills are an important manifestation the utility of the IS discipline as we are able to match the information processing needs of the organization to appropriate technologies. We have little doubt that when our disciplinary skills and expertise are appropriately utilized, and developed with the appropriate constituencies, that our discipline

supports a role for change that defines excellence in the field. Thus, the ultimate objective for the application of our skills is performance improvement – a goal based on outcomes and results rather than process for its own sake. Our skills, as ever, facilitate the achievement of organizational information-processing goals. Moreover, we must possess an intimate knowledge of the skills required to build systems - regardless of where they built and by whom they are built. The relationship between IT skills and the IS discipline is such that these skills are our cachet and represent our effectiveness.

Figure 1 presents our model of the relationship between IT Skills and the IS discipline which focuses on our curricular goal of developing successful graduates. The industry and profession exist on the basis of the characteristics and qualities of successful graduates. These characteristics are shaped by the skills our graduates learn, the core multi-disciplinary nature of the IS discipline, and our mission to understand and guide organizational use of technology. In this sense, the IS model curriculum is largely unchanged in how these characteristics are defined.

3. A CYCLE OF LEARNING

As we develop curriculum models in order to chart an appropriate course for the IS curriculum, we are also framing and reframing our discipline (Topi et al., 2007). Thus, given the nascent and changing nature of our discipline (while sentiment is arguable, we feel that ours is a juvenile discipline at this stage with all the attendant metaphoric implications), our judgment, wisdom and maturity is a moving target. In this light, it is clear that "...in the rapidly changing field of Information Systems, educational programs must be continually reevaluated and revised. This can be a daunting task..." (Noll and Wilkins, 2002).

Curriculum Design as a Learning Process

In our reflective processes of reevaluation and revision of the IS curriculum, we undertake parallel processes of decision-making and learning. Argyris (1977) has recognized that learning attendant to the outcomes and inputs to decision-making can be thought of as processes of error detection and correction. On this point Argyris asserts: "...Error is a mismatch: a condition of learning, and matching a second condition of learning. The detection and correction of error produces learning and the lack of either or both inhibits learning" (p. 365). Accordingly, decision-making must scan and probe for clues and trends in the environment such that fundamental and underlying assumptions of correctness and truth can be tested.

The problem space in which curricular design decisions are made is complex and evolving; there is an ever-increasing set of stake-holder-driven constraints such as those of the AACSB and ABET. Our need for learning is commensurate with the complexity and ambiguity inherent in the problem (Argyris, 1977). These issues are further confounded by fleeting consensus on curricular matters. This leads to a key impediment to learning:"...the degree to which interpersonal, group, intergroup, and bureaucratic factors produce valid information for the decision makers." (Argyris, 1977, p. 365). For instance, in the case of the IS discipline, there is evidence that a crisis of identity persists and persistently vexes this community (Orlikowski and Iacono, 2001; Weber, 2003; Benbasat and Zmud, 2003; Hirschheim and Klein, 2003). Thus, the clarity and validity of information for decision-making is certainly changeable, depending on context, within the discipline.

Argyris goes on to suggest that another important barrier to good decision-making and learning is: "...the receptivity to corrective feedback of the decision-making unit that is, individual, group, or organization (1977, p.365)." Presently, our choices for charting the way forward for our curriculum and discipline are no clearer than when Hirschheim and Klein (2003) proposed the following options: (a) let it die; (b) keep it on life-support; (c) take corrective action (learning); (d) rebirth. As our house is not necessarily in order - "...IS as a field needs to address its internal problems first so that it can better perform its external social roles..." (Hirschheim and Klein, 2003) - we are accordingly impeded. Put in another light, the identity crisis in IS, ranging perhaps over the duration of the discipline's existence, causes a schizoid tendency where the discipline develops theories of action which are in contention: Information Systems is unable to reconcile and resolve contradictions in its multi-/inter-disciplinary nature. This instability threatens our ability to maintain what should be natural leadership among the computing disciplines as IT continues to impact markets, organizations and societies. Viewed through

an even simpler lens: are we IT technicians, IT managers, both, or neither?

Argryis and Schon (1974, 1978) have referred to the type of disjunction inherent in the nature of IS in their espoused-theory vs. theory-in-use model of action. In this case, it may very well be that we in the IS discipline espouse a theory of action, specifically theories of action governing the decision-making for IS curricular issues, which highlights the inter/multi-disciplinary aspects of the field. However, given any number of biases, the theory-in-use of our actions often tilts towards some degree of polarization on the question: What is IS? For answering this question is fundamental to the design and modeling of curriculum choices.

Single-Loop and Double-Loop Learning

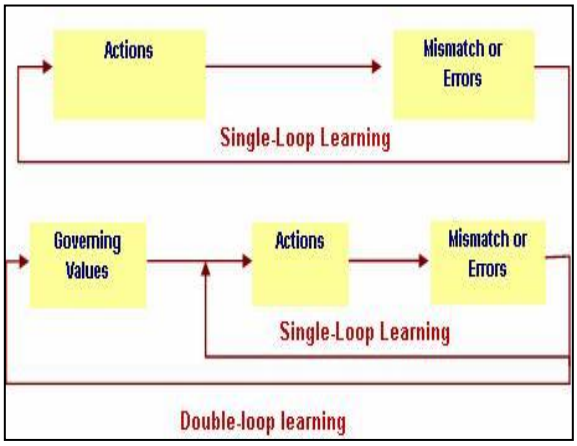
Argyris and Schön (1974, 1978) have augmented their theories of action by describing two models of learning: Single-Loop Learning and Double-Loop Learning. These learning models are important for identifying and ameliorating discrepancies between an espoused theory and a theory-in-use.

Therefore, when strength of one's programming and indoctrination is so pervasive in one's theories-in-use, the tendency exists to override or overcome the logic of the espoused theory. This manifests itself in IS curricular decisions depending on the indoctrinations inherent in the individual. Many IS professionals and scholars came into (and shaped) the IS discipline from a variety of antecedent and reference disciplines: Systems Engineering, Mathematics, Computer Science, Management, etc. Each of these disciplines has its own traditions and indoctrinations that can be traced from, to and through those that have built up the IS discipline. We now have, in the last 20 years, a cadre of professionals and scholars who have matriculated through "true-blue" IS programs, but we are far from unified. A quick read of departments and programs offering an undergraduate education in IS immediately gives the impression of identity crisis: our programs and departments are known by enough name variations to the point that we frequently must explain ourselves, and our monikers, to the lay-person. All of this suggests that creating a shared context for learning may be difficult for the IS discipline.

Single-Loop Learning

Our biases serve to influence a phenomenon known as Single-Loop learning. This form of learning usually reinforces these biases rather than lead to true learning: "… human behavior, in any situation, represents the most satisfactory solution people can find consistent with their governing values or variables, such as achieving a purpose as others define it, winning, suppressing negative feelings, and emphasizing rationality." (Argyris, 1977, p. 367). In this sense, fundamental and governing variables are not truly tested in the face of conflicting information and new decision-making strategies operate from a fundamental programming inherent in the theory-in-use. Figure 2 illustrates single-loop learning.

Figure 2 Single-Loop and Double-Loop Learning



Double-Loop Learning

Alternatively, there is double-loop learning, which overcomes the limitations of single-loop learning via reflective action. Double-loop learning is very difficult to achieve despite being readily recognizable when it is absent in others (Argyris, 1977; Argyris and Schön, 1974, 1978, 1996). The principle concern with double-loop learning is to examine one's governing variables (fundamental and programmed beliefs) and compare these to the outcomes of action (both failure and success). The rationality governing Double-Loop learning is not designed to protect a point of view but rather to gather the most perfect information possible.

In this sense, we frame the problem of curriculum modeling based on collective problem-solving where the risky and unpleasant exercise of questioning governing variables is pre-

requisite. Double-loop learning is illustrated in Figure 2.

The utility in assuming the philosophical and theoretic lens of Argyris and Schön's theories of action and learning is to characterize the non-trivial and iterative nature of the decision-making and problem-solving task that is curriculum design in Information Systems. That this is a difficult task has hopefully been supported thus far, but it is an imperative as the IS discipline remains in crisis. This crisis is somewhat tempered by the persistent value of IT skills: after all, IS has historically attracted large numbers of students as the match between those skills desired in the marketplace and the skills offered in programs was perceived as a good one. Thus, adding to the confusion is decisions on which skills to emphasize and how to sort fad from fundamentals. This is so as we seek to a) provide the necessary skills to prepare our students for entry-level positions in industry and b) provide students with a fundamental framework and background for ongoing and continuous learning (Lightfoot 1999).

Error Detection: Tracking IS 1997, IS2002 and IS2010

While the history of computing curriculum modeling has a 40-year history, the efforts of the past 20 years are of acute concern as they represent the years since our most recent and fundamental technology change: wide-spread uptake of the use of the Internet and, subsequently, the World-Wide-Web. As we consider the thread of efforts beginning with Longenecker and Feinstein (1991) through the IS2010 guideline (Topi et al. 2010), we can apply Argyris and Schön's theories on action and learning to understand how we have acted and reacted to change in our curriculum modeling and specification. Specifically, there are elements of the AIS/ACM IS2010 model curriculum which are welcome, but also choices which are questionable. In general, a pattern of error detection can be employed to understand potential disconnect between IT/IS professionals, academics and industry as we move forward.

Computer programming has long been our Achilles heel. It is often what sparks our booms and has also recently been at the heart of our busts. We now undertake an exercise where we examine the choice made in the AIS/ACM model curriculum to relegate programming to an elective. We examine the motivations for this and other changes to the model curriculum in the AIS/ACM document by referring to the reasons listed by Topi et al. 2007 as it lays out the plan for what became IS2010 (Table 2 in Appendix).

Our critique of the reasons and rationale for the changes proposed, and subsequently instituted, in the AIS/ACM IS2010 model curriculum are not actually a demonstration of the Double-loop learning exercise. Rather, this is an example of the opportunity for a reflective and discursive dialog toward the end of reconciling single-loop and double-loop learning in these particular matters. While options for comment and input have been available, we feel that these may not have been done in the spirit and practice of the double-loop learning. Of course it is imperative that our discipline entertain change and engage in change management, but to do so at the expense of fundamental skills is not to be taken lightly. We feel that this is an opportunity for the constructive process of double-loop learning as an exercise of error detection and correction. Towards this end, there are numerous opportunities for future research and collaboration.

5. FUTURE RESEARCH DIRECTIONS

An approach to realizing double-loop learning for curricular decision-making in support of an appropriate curricular model is to continue prior work in measuring and taking inventory and analysis of skills and competence (Davis, 2002; Landry et al., 2000; Landry et al. 2003; Wagner et al., 2009) using empirical evidence from measurements obtained via our industry contacts (alumni and otherwise).

Towards a Unified Model

The theoretical lens of reflective action and learning can be utilized to support efforts at specifying a family of curricula where each computing discipline may support multiple programs. We support the need for a common core amongst the computing disciplines, but also recognize that programs can and should be different due to electives. Programs are, in practice, variable; there can and will be huge philosophic differences between two programs. We recognize that a given program is unique and provides a unique curricular target for students, faculty, local industry leaders, and other stakeholders to attain.

We advocate for a curricular model where a flexible and tailored "theme" defines a program's content along with a skill hierarchy, a reckoning of which jobs are attainable by a graduate with these skills, and other personal characteristics (Figure 1). A single theme per program is essential so that each faculty member can learn and relay its theme and jobs to anyone asking. Goal-setting leads to goal-seeking, which leads to goal attainment.

Skills must be achieved as the curriculum advances through a series of courses. The time to learn the necessary skills is during the actual course. As evidence of "progress" being made, courses are factored into a set of program outcome statements which are behaviorally expressed. These outcomes, in their development, require considerable application of critical thinking to ensure that the statements express the desired contents. These are the elements of Figure 1.

We feel that such a system lends itself well to utilizing reflective double-loop learning as we are willing to revisit our theme in conjunction with core skills as the environment necessitates. Importantly, we feel that our core skills should be jealously guarded such that we look for ways to add to these core skills rather than allow short-term perturbations to upset our focus on these core skills.

Tracking Skills

In support of our vision for a unified curriculum model, there is a need to continue the work of Landry et al. (2000, 2003) in keeping track of core and fundamental skills as they relate to jobs. It is imperative that we ascertain if the work of Topi et al. (2007, 2010) is fundamentally correct. There is value, at the very least, in triangulating results. We feel that our task is to cultivate and extend our core skills, as expressed in Table 1, as technology progresses. This position is in opposition to weakening our core skills by relegating them to sidelines; to be pursued as a track of interest. Fundamentally we ask: if we are not about designing, building, implementing and maintaining information systems, then what are we? Our original core skills, as expressed in IS97 and IS2002, are likely correct and new trends have not been in place long enough to alter them.

Tracking and Mapping Industry Constituents

Another future direction in the area of skills assessment, proposed initially by Abdullat and Babb (2010), is to better track industrial and alumni advisory boards for the purpose of keeping abreast on trends in skills requirements and demands. For curricular decisions related to skills building, leveraging the extended network of industry professionals connected to a given institution's program, it's graduates, and industry constituents is valuable in order to determine a richer picture of the skills-to-jobs matching. This would involve performing a periodic Social Network Analysis on the industrial advisory board and perhaps sharing these in a wider network to achieve (or leverage) the advantages of similar professional social networks, such as LinkedIn. Social Network Analysis can be a strategy for understanding and selecting a sample for further survey measurement of skills. Furthermore, the results of such a survey can be compared with the social network for a mixed-methods analysis. This would allow for a better understanding of the regional aspects of the jobs/skills relationship. Social Network Analysis is gaining more acceptance as a decision and visualization tool as the idea of social networks in general is enjoying greater societal uptake (Boyd and Ellison, 2007; Mislove et al., 2007). The utility in this approach is to understand and manage our relationship with our industry partners: both for learning and for focusing and refocusing this relationship on our shared tasks. Embraced in symbiosis, it is imperative that both educators and industry professionals work to clarify goals for skills development in light of each party's constraints. However, we in the academy have a higher imperative to temper the market-induced vacillations experienced by our partners in industry by taking a longer view on our core and fundamental skills.

6. CONCLUSION

Our opportunity to engage in double-loop learning in curriculum decision-making lies with our ability to; a) come to grips with knowledge that is fundamental to the discipline and b) recognize which skills are fundamental to our discipline. We should, in equal measures, a) remain sensitive to the needs of industry; b) educate industry regarding our core-competency of knowledge and skills; and c) remain true to our students by instilling a long-standing tradition of core skills and knowledge which stand the test of time. We can only accomplish these goals by engaging regularly in

processes of reflective action and learning which promote self-critical double-loop learning. This entails both the courage to change and the wisdom and reflection to fit changes into our wider framework of core knowledge and skills. From this we will all benefit: the industry, our students and the discipline at large.

7. REFERENCES

Abdullat A. & Babb J.S. Leveraging the Advisory Board for Regional Institutions as a Critical Nexus for Program Accreditation. *ABET Symposium 2010*, April 15-17, Las Vegas, Nevada

Argyris, C. (1977). Organizational learning and management information systems. *Accounting, Organizations and Society*, 2(2), 113-123.

Argyris, C. & Schön, D.A. (1974). Theory in practice: Increasing professional effectiveness. San Francisco: Jossey-Bass.

Argyris, C. & Schön, D.A. (1978). Organizational Learning: A Theory of Action Perspective. Reading, PA: Addison Wesley.

Argyris, C. & Schon, D.A. (1996). Organizational learning II: Theory, method and practice. Reading, PA: Addison Wesley.

Anderson, P & Tushman, M. L. (1990). Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change. *Administrative Science Quarterly*, 35(5), December, 604-633.

Baskerville, R. L. & Myers, M. D. (2002). Information Systems as a Reference Discipline. *MIS Quarterly*, 26(1), 1-14.

Benbasat, I. and Zmud R. W. (2003). The Identity Crisis within the IS Discipline: Defining and Communicating the Discipline's Core Properties. *MIS Quarterly*, 27(2), 183-194.

Boyd, D.M. and Ellison, N.B. (2007) Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication*, 13(1), 210-230.

Davis, G., J. T. Gorgone, J. D. Couger, D. L. Feinstein, and H. E. Longenecker. (1997). IS'97: Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. *ACM SIGMIS Database*, 28(1).

Carr, N.G. (2003). IT Doesn't Matter. *Harvard Business Review*, 81(5), May, 29-41.

Friedman, T. L. (2005). The world is flat. New York: Farrar, Straus and Giroux.

Glass R. L., Ramesh, V., Vessey, I. (2004). An Analysis of Research in Computing Disciplines. *Communications of the ACM*, 47(6), 89-94.

Gorgone, J., G. Davis, J. Valacich, H. Topi, D. Feinstein and H. Longenecker. (2003). IS 2002 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. *Data Base* 34(1).

Granger, M.J., Geoffrey, D., Jacobson, C. M., Van Slyke, C. (2007) Information Systems Enrollments: Challenges and Strategies. *Journal of Information Systems Education*, 18(3), 303-311.

Gurbaxani, V. and Whang, S. (1991). The impact of information systems on organizations and markets. *Communications of the ACM*, 34(1), 59-73.

Hirschheim, R. A. and Klein, H. K., Crisis in the IS Field? A Critical Reflection on the State of the Discipline. *Journal of the Association for Information Systems*, 4(1), Article 10.

Keen, P. (1981). Information Systems and Organizational Change. *Communications of the ACM*, 24(1), 24-33.

Klawe,M. and Shneiderman, B. (2005). Crisis and Opportunity in Computer Science. *Communications of the ACM*, 48(11), 27-28.

Kroll, C. A., Lee, D., Shams, N. (2010) The Dot-Com Boom and Bust in the Context of Regional and Sectoral Changes. *Industry & Innovation*, 17(1), 49-69.

Landry, Jeffrey P., Longenecker, Herbert E. Jr., Haigood, Brandon, and Feinstein, David L. (2000). Comparing Entry-Level Skill Depths Across Information Systems Job Types: Perceptions of IS Faculty. *Americas Conference on Information Systems* (AMCIS 2000), August 2000, Long Beach, California.

Landry, J.P., Reynolds, J.H., and Longenecker, H.E. Jr. (2003). "Assessing Readiness of IS Majors to Enter the Job Market: An IS competency Exam Based on the Model Curriculum." Proceedings of the 2003

Americas Conference on Information Systems, August 4-6, Acapulco, Mexico.

Landry, J. P., Pardue, J. H., Longenecker, H. E., Jr., Feinstein, D. F. (2003). A Common Theme for IT Degree Programs. *Communications of the ACM*. 46(11), 117-120.

Lightfoot, J. (1999). Fads versus Fundamentals: The Dilemma for Information Systems Curriculum Design. *Journal of Education for Business*, 75(1), p.43.

Longenecker, H. E., Jr., and D. L. Feinstein. (Eds.) (1991). IS'90: The DPMA Model Curriculum for Information Systems for 4 Year Undergraduates. Park Ridge, Illinois: Data Processing Management Association

Lenox, T.L., Woratschek C.R., and Davis, G.A. (2008). Exploring Declining CS/IS/IT Enrollments. *Information Systems Education Journal*, 6(44). 3-11.

Markus, M. L. and Robey, D. (1988). Information Technology and Organizational Change: Causal Structure in Theory and Research. *Management Science*, 34(5), 583-598.

Mislove, A., Marcon, M., Gummadi, K. P., Druschel, P., and Bhattacharjee, B. (2007). Measurement and analysis of online social networks. *In Proceedings of the 7th ACM SIGCOMM Conference on internet Measurement,* October 24 – 26, San Diego, California, USA.

Noll, C.L. and Wilkins, M. (2002). Critical Skills of IS Professionals: A Model for Curriculum Development. *Journal of Information Technology Education*, 1(3), 143-154.

Orlikowski, W. J. (1993). CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development. *MIS Quarterly*, 17(3), 309-430.

Orlikowski, W., Iacono, C. (2001). Research commentary: desperately seeking the "IT" in IT research—a call to theorizing about the IT artifact. *Information Systems Research*, 12(2), 121-134.

Reihlen, M., Albers, S., Kewitz, T. (2009). Internationalization as Strategic Change: The Case of Deutsche Treuhand-Gesellschaft. *Management Revue*, 20(2), 209-234.

Silver, M.S., Markus, M.L., Beath, C.M. (1995). The Information Technology Interaction Model: A Foundation for the MBA Core Course. *MIS Quarterly*, 19(3), Special Issue on IS Curricula and Pedagogy, 361-390.

Sprague, R.H. and McNurlin, B.C. (2007). Information Systems Management in Practice, 4th edition, Prentice Hall PTR Upper Saddle River, NJ, USA.

Topi, H., Valacich, J. S., Kaiser, J., Nunnamaker, J. F., Jr., Sipior, J., d.Vreede, G.J., Wright, R.T. (2007) Revising the IS Model Curriculum: Rethinking the Approach and the Process. *Communications of the Association for Information Systems*, 20(45), pp. 16.

Weber, R. (2003). Still Desperately Seeking the IT Artifact, *MIS Quarterly*, 27(2), pp. iii-xi.

Woratscheck, C.R. and Lenox, T.L. (2009). Defining CS, IS, and IT: Are We There Yet? *Information Systems Education Journal*, 7 (59).

Appendix

Table 2 Motivations and Responses to Change in IS2010

Topi et al. 2007 Motivations	Error Detection and Correction Response
1. Complex globally distributed information systems development – The full extent of the distributed nature of IT development was not fully visible during the development on the previous curriculum. The skills needed by IS graduates have, consequently, changed significantly. Increasingly, many IS jobs for business school graduates require capabilities in the management of globally distributed development resources.	We feel that there is some validity regarding the full impact of distributed, pervasive and ubiquitous computing. However, we posit that the skills required to understand a globally-distributed system and still included development skills. Must be take care not to replace "hard" skills and with "soft" skills when our concern is managing systems. A key component of managing these projects is understanding their essence.
2. Web technologies and development – Mature modeling and development platforms for the web environment have become a core part of IS development.	We fail to understand the utility in differentiating web technologies and development from the skills and knowledge inherent in software and systems development; for which we have a long and right history. Our goal is to incorporate Web development into our existing framework, not pretend it is a new species. Web development is an evolution of software development/programming. Again, we need to establish the long-standing tradition in our skills.
3. ERP/Packaged software – Information systems and business processes have become closely integrated, and increasingly often, core infrastructure applications are based on large-scale enterprise systems so that the focus is shifted from development to configuration.	We wonder, in practice, how will this be done? An understanding of software and systems development lends itself to the scripting/programming often required to "glue" these pieces together and integrate them. Again, relegating programming and development will put us further away, not closer, to this subject area. Often, getting things done with these packaged frameworks involves going a step beyond into development skills. Moreover, what of the SME's and their computing and systems needs? There are many things we can do with Wizards and similar tools, but the real power opens up with those with development skills. Futhermore, some of our graduates, who have gone on to work with PeopleSoft, JD Edwards and SAP have needed to customize, configure and extend the base packages with their development skills. The list goes on: Sys admins and DBAs (and other sorts of infrastructure people) each need to write scripts and queries requiring programming skill.
4. Ubiquitous mobile computing – Global orga-	Yes, and we need to learn how to develop for

nizational life using a variety of devices has become dependent on mobile and ubiquitous platforms.	these devices and integrate them into our existing architectures. Ubiquity is also about convergence and integration.
5. IT control and infrastructure frameworks – Frameworks and standards such as COBIT, ITIL, and ISO 17799, have become very important sources of guidance for IT/IS practices in organizations. Not salient to our arguments	We see that the majority of these motivations all assume that the need for basic IT skills, to include programming, have somehow faded. Moreover, we are searching for the international perspective in Topi et al. (2007). There are people in other markets and economies doing extensive work on the mechanics of programming and development and are, accordingly, becoming stronger professionals as they are engaging skills that are close to the heart of our discipline - the development of IT.