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An Adaptive Structuration Framework for Inter-organizational Social Informatics: Appropriating Advanced Information Technologies in Industry/Academic Collaborations

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ABSTRACT

Industry/academic collaborations, involving the utilization of advanced information technologies (AITs) is an expanding phenomenon involving a substantial commitment of resources. This paper presents a comprehensive framework that extends Adaptive Structuration Theory to the inter-organizational level.

INTRODUCTION

Social informatics literature provides many studies of the effects of advanced information technology (AIT) on individuals, within organizations, and upon society en masse (Kling 1999). The deployment of AITs in academia presents an opportunity for exploration of social informatics at the level of inter-organizational relationships. However, previous studies have not presented models explaining the impact of AITs on collaborations between organizations. This paper presents a theoretical framework, based upon Adaptive Structuration Theory, for understanding how AITs influence transformations in industry/academic collaborative relationships.

Collaboration can be defined as a joint effort "… wherein each party provides specific products and services toward a common goal" (Beckman, Coulter, Khajenoori, & Mead 1997, p.50.). Given the respective strengths of each entity, many educators and industry representatives feel collaborative relationships can provide opportunities and resources not otherwise attainable. In practice, these relationships range from informal guest speakers to formal joint venture graduate programs (Mead, Beckman, O'Mary, Parish, Unipingco, & Walker 1999; Sikkel, Spil, & van de Weg 1999). Relationship challenges include facilitating mutual understanding, clarifying expectations and addressing the respective goals of each organization.

AITs currently appropriated in university settings include computer-aided software engineering tools, enterprise resource planning systems, and database management systems. The use of these large-scale software systems in business and engineering curricula follows industry demand and a desire for employable graduates. These manifested collaborations raise questions about the selection of educational processes, depth and breadth of system use, roles of vendors and independence of academics. Additionally, the cost of utilizing valuable and scarce resources from both organizations merits the assessment of benefit.

Without a framework that identifies relevant variables, it is difficult to assess the impact of adoption, identify effective deployment processes, and analyze costs and benefits. Hence, we propose a framework to 1) provide a theoretical model for understanding the integration of AITs within educational settings and 2) develop a set of propositions for future research. Though frameworks for industry/academic collaborations exist (Mead, Beckman et al. 1999), none have considered the implications of AITs on the evolution of collaborative relationships.

We begin by setting industry/academic AIT collaborations within the framework of Adaptive Structuration Theory (DeSanctis & Poole 1994). Next, we set forth propositions to guide future research and explicate supporting interrelated constructs within the matrix of social and technical dependencies comprising industry/academic collaborations. We introduce our constructs through example by using enterprise systems within the context of colleges of business. We exemplify using enterprise systems since the level of commitment required for adoption of these high-demand systems suggests the potential for a considerable effect size.

Theoretical Framework - Adaptive Structuration

Collaborative practices are not fixed in time, but follow an evolutionary course of "production and reproduction across time and space", known as structuration (Giddens 1982). Such systems evolve through iterative social actions between organizational actors. The application of institutional resources in the course of daily life shapes the long-term development of institutions (Giddens 1979). Structuration theory provides a basis for theorizing about the relationships between technological change, beliefs, action and structures (Kling 1994).

As an extension of structuration theory, Adaptive Structuration Theory (AST) has been used as a framework to study organizational change occurring as AITs are utilized. This perspective posits that the adoption of an advanced technology is a process of organizational change that results from the mutual influence of the technology and social processes (Poole &

DeSanctis 1992; Gopal, Bostrom & Chin 1993).

Within AST, the outcome of action is both structure and structuring (product and process) that can set the conditions for its own continuation (Shotter, 1983). It is our premise that human actors and organizational context are moderators of the dynamic impacts of AITs appropriated in academic settings where each collaborative entity strives to fulfill its own needs. Such dynamics have an effect not only on the outcome of the appropriation, but also on the evolution of the relationship between industry and academia.

Structuration has at its core motivated and practical actions. Those interacting in the structuration process possess both the general knowledge of the relevant system's structural properties and the capability to follow another course of action (Giddens 1982). AIT appropriation strategy has been addressed by academic organizations in a variety of ways ranging from adding exemplary material within existing courses to creation of new degree programs. We suggest it is the implicit structures underlying the collaboration system in conjunction with the technology and educational activities that affect appropriation of the AIT, the education process, potential joint outcomes and the structure of the collaborative relationship.

Our model is graphically represented in Figure 1 with detailed constructs and attributes listed in Table 1. The model provides the basis for the propositions that follow.

THEORETICAL PROPOSITIONS

P1 - To the extent that AITs vary in their structural and spirit feature sets, the depth and breath of appropriation in academia will affect the level of academic/industry collaboration.

Two ways have been suggested to describe the contributing social structures offered by an AIT. The first, "structural features", refers to the types of rules and resources offered by the system. The second, "spirit", can be thought of as the intended purpose and utilization of the system (DeSanctis and Poole 1994).

Structural features of enterprise systems include a comprehensive suite of applications supporting diverse organizational functions. Enterprise systems contain many modules geared toward different processes, each requiring unique training. Academic organizations, either independently or with industry assistance, must decisively negotiate this rich feature set to achieve educational objectives.

The spirit of enterprise systems can be described as information technology structures designed to integrate transaction processing, decision support and strategic management systems. However, the goals of enterprise system use in colleges of business are primarily educational and exploratory in nature. Even beyond this natural gap, choices in the depth and breadth of adoption prompt varying appropriation moves that diversely affect courses, curriculum tracks and collaborative arrangements.

P2 - The nature of academic/industry collaboration depends upon external sources of structure such as technology-enabled labor supply, AIT market competition and academic accreditation standards.

Market demand is one external structure that impacts collaborative evolution and the breadth and depth of appropriation. The American Accounting Association reported that "the markets for accounting students will drive the 'models' of education, including delivery, content and pedagogy" (American Accounting Association 1998). Similar effects can be expected in information systems as the demand for professionals who can understand, develop, and utilize enterprise continues to grow (Watson and Schneider 1999).

P3 - The nature of industry/ academic collaboration depends upon the technological infrastructure required to deploy AITs in academic settings.

A practical component in any study of the appropriation of AITs is a basic cost/benefit analysis. Are the total system costs incurred rewarded with an enriched educational experience and employable graduates? Enterprise systems typically require a significant commitment of academic resources. System deployment typically requires industry support extending beyond software or hardware donation (Watson and Schneider 1999). Hence, some form of service relationship seems a precursor for the existence of these systems in academic settings.

P4 - The nature of industry/academic collaboration depends upon academic organizational structures, such as academic departments, program requirements, and course objectives.

The philosophy concerning the balance between conceptual technology education and the development of technology skills varies by organization. Enterprise system appropriation has been used to: 1) emphasize the informational aspects of enterprise topics (Gibbons and Fairweather 1998); 2) create environments for experiential learning; and 3) develop specialized program tracks (Watson and Schneider 1999; Becerra-Fernandez, Murphy & Simon 2000).

Furthermore, the educational entity's organizational structure shapes its perspective on industry involvement, use of technology, and response to industry and student demands. This ultimately affects the collaborative relationship.

P5 - Modified educational methods emerge as the technology and educational processes are utilized and facilitated by industry/academic collaborations.

Modifications in educational method evident in software engineering research on industry/academic collaborations suggest appropriation moves that can influence collaborative relationships involving AITs including:

- Accelerated internship programs (Powell, Diaz-Herrera & Turner 1997).
- Independent study support.
- Industrially experienced teachers (Wohlin and Regnell 1999).
- Vendor-sponsored training programs (Beckman, Coulter et al. 1997).
- Jointly developed courses (Wohlin and Regnell 1999).
- Participation in maintenance efforts.
- Case study development (Sikkel, Spil et al. 1999).
- Research within industry (Wohlin and Regnell 1999).

P6 - New forms of industry/academic collaboration emerge as AITs facilitated by collaboration are deployed in academic settings.

The collaborative system is not a recognized organization, but a structured social practice of interdependence having a broad spatial and temporal extension (Giddens 1982). There are no global, formalized standards for the appropriation of enterprise systems in educational settings or for industry's role, however implied dynamic rules, such as the importance of a central coordination point, emerge from the process (Powell, Diaz-Herrera et al. 1997). The existence of organized alliance programs may be considered a representation of social practices affecting the collaboration structure.

P7 – The joint outcomes of introducing AITs in academic organizations are dependent on the:

- AIT,

Table 1. Constructs of interest for future research

Construct	Attributes
Advanced Information Technology Structure: Enterprise systems	◆Structural Features (*Restrictiveness; Level of sophistication,; Comprehensiveness (suite of applications supporting diverse functions); Learning Curve)* ◆Spirit (*Enterprise-wide Strategy; Daily operations; Management support system; Strategic planning tool; Convergence with educational goals)*
* External Environmental Structure	◆Accreditation standards ◆Curriculum studies ◆ Technology vendor market position and status ◆Industry standards ◆Technology trends ◆Technology market competition ◆End user demands ◆Technology-enabled labor supply
Technology Infrastructure	• Software •Hardware •Internal maintenance •Software support •Database creation and maintenance 1. Student remote access 2. Computer lab facility 3. Industry donation or grants to support technology infrastructure
Educational Organization Structure	• Departmental structure •Major program requirements •Course objectives • Instructor preferences
Education Process	◆Learning Models – (*Collaborative learning; Hands-on experience; Simulations; Conceptual presentations; Programmed instruction; Real-world exposure; Case studies)* •Supporting Technologies – (*Textbooks on technology; Presentation tools; Asynchronous communication tools; Synchronous communication tools; Computer based training modules)*
Modified Forms of Educational Method	◆Educators enrolling in corporate training programs ◆ Project/task specific internships ◆Industry experts participating in classroom presentation ◆Students/educators participating in AIT specific list serves ◆Credit and/or increased access to technology training programs for students ◆Industry development of targeted educational tools, databases, and exercises
Joint Outcomes	• Student learning/education in technology arena ◆ Employable students ◆ Increased work pool ◆ AIT market exposure ◆ Contribution to industrial research and development effort ◆ Contribution to academic research ◆ Continued/enhanced program attractiveness
Structure of Academic/ Industry Collaborations	◆Rules (*Industry participation in curriculum development studies; Inclusion of AIT in curriculum development research ; Academic participation in industry development; Educator participation in corporate* tr*aining programs)* •Resources (*Technology alliance programs; Opportunities/invitation for field*

- External structure,
- Technological infrastructure,
- Organizational structure,
- Appropriation process, and
- Educational process.

Desired joint outcomes include facilitating the educational mission, gaining competitive advantage, accessing educational resources, enhancing reputation, increasing revenue, and providing a staffing source (Mead, Beckman et al. 1999). The college, industry, or both may desire each of these goals.

Just as success is not guaranteed in implementing an AIT in an industry setting, desired joint outcomes from academic appropriation are not guaranteed. There are potential outcome risks an educational entity may experience even if "desired" outcomes are achieved. One risk is a myopic focus on short-term educational tasks (Wohlin and Regnell 1999) rather than on fundamental concepts. Another risk is integrity and independence as a college of business becomes known as an Oracle, SAP, or Sybase "shop". Academics should be aware of the risks and address them accordingly in their AIT appropriation, collaboration decisions, and research of this phenomenon.

FUTURE RESEARCH

AIT appropriation and associated collaboration decisions may affect the educational foundation and career prospects of the technological work force, calling for further research to investigate this phenomenon. Appropriate methodological approaches should be considered in examining theoretical constructs. Survey, case studies, and quasi-experimental studies seem appropriate. One avenue is to formulate hypotheses based upon the propositions presented and directly test the model. For example, researchers may investigate the implications of various alliance programs or appropriation methods at different colleges.

From a practical perspective, industry and students often desire an emphasis on practical training and education from academic organizations. However, the costs of AIT appropriation may be high and the impact on educational processes and collaborative relationships uncertain. Stakeholders should recognize the potential influence of structure and social context on desired outcomes when embarking on the process of industry/academic collaboration.

CONCLUSION

AST recognizes that technology appropriation may be a key factor in the evolution of affected social structures. AST gains predictive and descriptive power by addressing social complexities and actions as factors closely integrated with advanced information technologies. An extension of AST as a research framework for industry/academic collaborations is the major contribution of this exposition.

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