Appropriating Enterprise Resource Planning Systems in Colleges of Business: Extending Adaptive Structuration Theory for Testability

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ABSTRACT

Enterprise resource planning systems are a form of advanced information technology that is quickly becoming commonplace in colleges of business. The nature of software, industry involvement, and academe influences how enterprise resource planning systems are integrated into business education processes. The appropriation of these systems in an academic setting involves a great deal of change, which, if not carefully considered, could result in failure to achieve mutually beneficial outcomes for students, the academic institution and industry stakeholders. Adaptive structuration theory provides a conceptual change model that helps capture the longitudinal change process. In order to provide a better understanding of the periods of routine use at the center of adaptive structuration theory, we introduce theory from the concerns-based adoption model. We integrate aspects of these two theories in the academic setting to provide a theoretical framework that explains the enterprise resource planning systems appropriation process and provide a method for studying the utilization of advanced information technologies for educational purposes. This framework may also be used as a practical means of identifying and considering appropriation issues when planning and evaluating enterprise resource planning systems usage in the classroom.

Keywords: Innovation Configuration, Enterprise Resource Planning System, Adaptive Structuration Theory, Business Education, Technology Adoption

1. INTRODUCTION

A good understanding of Enterprise Resource Planning (ERP) systems is becoming essential for the aspiring business professional, and is now considered by some a price of market entry for many businesses (Kumar and Van Hillegersberg, 2000). Critical business applications such as supply chain management and e-commerce rely on ERP systems, thus driving market expansion. Though it initially focused on technology-driven issues, ERP systems development has shifted its attention to business-driven issues and the effect of the ERP on the bottom line (Menezes, 2000). In response to this market-driven environment and the need for currency in business education, many university business departments have implemented the use of advanced information technologies

(AITs), including ERP systems, in their classrooms to enrich the educational process and to satisfy the demands of students and employers.

The application of AITs such as ERP systems in the classroom has implications for student performance, academic department infrastructure, and course content that could lead to far-reaching changes in business education. Additionally, the level of commitment required to adopt these systems, their interdisciplinary nature, and level of systems sophistication (Kumar and Van Hillegersberg, 2000; Sumner, 1999) present an intriguing area of study within an academic context. Surprisingly, research on key ERP issues in business education has been sparse (Hayes et al., 2001).

At the heart of the opportunities presented and the challenges to be overcome in the deployment of ERPs in industry and colleges of business is configurability. Configuration capabilities are afforded through discrete features and options within each ERP module. These capabilities purport to enable a "tailored fit" to business policies, practices, and ways of organizing work (Fichman and Moses, 1999). Appropriate configurations in industry integrate applicable best practices embedded in software feature options (Williams, 1997) with use patterns that are consistent with a particular organization's structure to arrive at a "fit" or "situated appropriation pattern." Just as an understanding of configurations is essential to the successful adoption of ERP systems in industry, an understanding of the implications of various configurations in academe is essential to the successful adoption of ERP systems in the classroom.

However, the study of successful appropriation patterns in industry has limited application when studying the use of ERPs as learning tools in colleges of business. There are valid distinctions among the nature and objectives of ERP appropriations in academic and industrial contexts, respectively. Aside from considerations concerning organizational structures and purposes, the technological reality is that ERP systems were designed with industrial best practices in mind (the spirit of ERPs is industrial). ERPs were not designed to be learning tools that embody educational best practices. The purpose of this conceptual paper is to propose a model derived through inductive development that can depict the appropriation process and associated variables in a way that is useful for understanding outcomes that are relevant to the academic community. This proposed model may be used to guide research by identifying potential relationships among key variables, and to provide educators with a framework for planning and evaluating the appropriation process.

The context of the proposed research model views technology adoption as a highly discontinuous or episodic process in which users alternate between short periods of intensive adaptive activity and longer periods of routine use (Tyre and Orlikowski, 1996). To address this viewpoint, we integrate a theory that supports a longitudinal perspective of evolution in information technology adoption, the adaptive structuration theory (AST) (DeSanctis and Poole,1994), with a theory that recognizes longer periods of routine use of the technology within the domain of education, the concerns-based adoption model (CBAM) (Hall and Hord, 1987). Specifically, we integrate constructs from the CBAM to provide a mechanism to ground AST constructs for a more concentrated study of successful adoption patterns, while recognizing the possibility of change in appropriation patterns. CBAM theorists have developed protocols for measuring variables associated with the appropriation of educational innovations during periods of routine use. These protocols may be applicable to the use of ERP systems in colleges of business. The integration of these two models aids one's understanding of the complexity of adopting ERP systems in colleges of business and provides a basis for measuring, testing, and prescribing various approaches of adoption. The premise of the integrated model is based on a review of existing literature, action research from one author's experience in implementing and using ERP systems (as an ERP vendor representative and user), content analysis of academic list serve discussions of ERP systems, information systems and computer science curriculum guides, and unstructured interviews with ERP users.

In the next section we introduce the model. We then discuss constructs and relationships within the context of their theoretical sources, AST and CBAM. This paper concludes with a discussion of research propositions and opportunities for future work.

2. OVERVIEW OF MODEL: HIGH LEVEL CONSTRUCTS

Our model introduces four high-level constructs: structure profile, appropriation pattern, level of use, and outcomes (See Figure 1). The structure profile represents the rules and resources (materials, information, and discourse) provided by ERP technology, the environment, and social systems (i.e. academics and industry actors engaged in the deployment of ERPs in colleges of business). The structure profile affects user decisions, actions, and style of technology appropriation.

The stakeholders' actions and decisions when deploying ERPs in colleges of business are called appropriation moves. These moves alter how the technological system is used. According to systems theory, systems tend to move toward states of equilibrium (Katz and Kahn, 1996) or routinization. A routine arrangement of appropriation moves sustained over a certain period defines its state, referred to as the appropriation pattern. When adopting ERP systems for the classroom environment, two key elements of an appropriation pattern emerge: (1) the degree to which the technology is used as intended (faithfulness) and (2) the teaching model used to design the classroom experience (the educational process). The fundamental nature of our model contends that appropriation patterns exist when deploying ERPs in colleges of business, and that

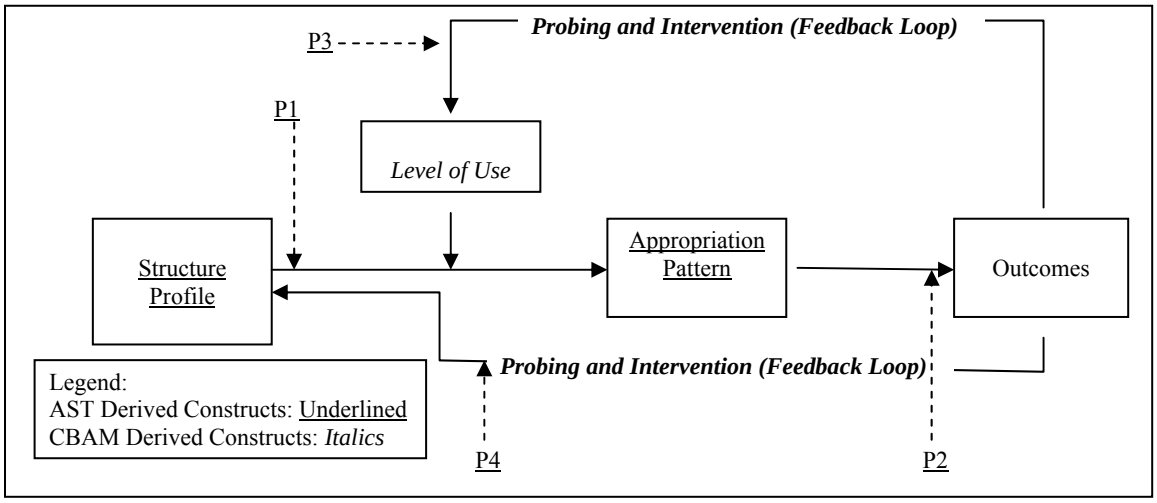

Figure 1. Proposed Integrated Model for ERP Systems Appropriation in Academe: Major Concepts Only

any given appropriation pattern will serve some users better than others during episodes of routine use

Levels of use are behaviors which educators develop as they become more familiar with, and more skilled at, using educational innovations (Loucks et al., 1976) such as ERP systems. The relationships among high-level constructs in our model indicate that the levels of ERP systems use (behaviors of academics) within colleges of business moderate the effects of the structure profile (rules and resources) upon appropriation. Our model recognizes change while focusing on routine patterns of use. The model implicitly indicates that routinization flows from continued patterns of systems use, especially if the outcomes are acceptable.

The outcomes of ERP deployment in colleges of business include stakeholder attitudes toward academe-industry collaboration, instructor attitudes toward the appropriation, educational effectiveness (e.g., increased work pool of market-ready applicants), new or enhanced educational resources, and instructor benefits. Positive outcomes are a consequence of appropriation patterns that are aligned with the structural profile and with the desired level of use. The most beneficial appropriation patterns (methods of use) should be the ones most aligned with the level of use and the structure profile. The implied promise is that, given a structure profile and desired level of use, the best educational practices used with ERP systems (appropriation patterns) can be identified.

Outcomes guide the probing and intervening actions so as to either maintain equilibrium or spawn episodes of intense adaptive activity. Within the context of academic ERP implementations, intervening and probing actions resulting from outcome assessments affect the evolution of structures (including the relationships between industry and academe), as well as the level of use of the technology. Discrepant outcomes, both positive and negative, including new discoveries about the systems or the appropriation, can catapult a change in appropriation patterns or sustain existing ones.

In the next sections we expand on our model. We provide quotes from our content analysis of academic list serves (threads concerning the appropriation of ERPs in academe) to ground our synthesis derived from literature, experience, and informal interviews. This analysis infers that educational uses of ERP systems are socially constructed through discourse and action.

3. STRUCTURE PROFILE

Adaptive Structuration Theory is a mechanism for examining change processes in an organization by looking at the types of structures provided by advanced technologies (inherent structures) and at the structures that actually emerge in the deployment of such technologies as people interact with the system (DeSanctis and Poole, 1994). The adaptive structuration model introduces human actors and the organizational context as moderators of the impacts of technology (Gopal et al., 1993; Poole and DeSanctis, 1992). Adaptive structuration recognizes, through user actions and decisions (appropriation moves) throughout the organizational life cycle of the system, the dynamic nature of technological appropriation.

In applying AST to the educational context, the ERP configuration and its application within a college of business are interactive processes driven by education stakeholders, ERP software stakeholders, environmental influences, and the technology itself. The appropriation of advanced technologies cannot be seen independently from the socio-political process (actions, decisions, and interactions) among industrial and academic actors, and among academic actors within the respective colleges. Software vendors engaging with academe essentially "speak" for the technology through marketing efforts,

materials, academic programs, demonstrations, training programs, etc. (Bloomfield and Danieli, 1995; Orlikowski et al., 1995). Key elements (sub-constructs) of the structure profile for implementing ERP systems in colleges of business include the ERP structure, technological infrastructure, organizational/internal structure, collaboration structure, and environment (e.g. cultural, technological, market conditions).

3.1 ERP Structure

ERPs offer a comprehensive suite of structural features that support diverse organizational functions and processes (Hayes et al., 2001). ERP vendors offer application suites consisting of various modules from which businesses can pick and choose to meet their specific systems needs (e.g., see www.sap.com, www.oracle.com, and www.peoplesoft.com for product details). This array of functionality provides many choices, but the associated software's complexity is sometimes overwhelming:

"The main problem with the ERP concept is that it is very complicated – lots of information scattered over different software modules which interact with each other in complex ways. Without a 'divide and conquer' learning strategy, the student can easily get lost in the multiple screens of the software"(Network, March 13, 2002).

The expansive structure of these systems creates a time challenge not easily reconciled with the concept of a college semester, as this academic explains:

"We have come to a definite conclusion that one cannot teach in one semester a complex software system like SAP or Oracle applications"(Network, March 13, 2002).

The college of business department that appropriates an ERP system must address the constraints and opportunities provided by the structure of the ERP. The nature of an ERP system consists of two elements: structural features and spirit. "Structural features" refer to the rules and resources offered by the system; "spirit" is the intended purpose for utilization of the system and is addressed in the forthcoming discussion of faithfulness (DeSanctis and Poole, 1994).

3.2 External Environmental Structure

The external environment, which includes regional and national cultures, varies as ERP systems are used in various educational environments. These environmental differences may affect the structures of the educational institutions, as well as the expectations of students and their future employers. Predictions and assessments of the early 21st century indicate that the North American market for information systems professionals who could understand, develop and utilize ERP systems to be strong and growing (Watson and Schneider, 1999). New avenues of opportunities are emerging in e-commerce and supply chain management (Stedman, 2000; Wilson, 2000). This market demand for ERP-aware business graduates creates a "push" structure to introduce ERP systems, and perhaps even specific vendors or modules, into the educational process.

"It looks like the companies that hire our students will be demanding that our students know something about ERP technology in the future. As a practical matter, it's probably good to be able to respond to that demand"(Serve, 1999).

External forces may exert pressure on colleges of business to not only implement ERP systems, but to also exert force regarding which specific systems to implement:

SAP - *"We have chosen SAP because most of our business collaborators use it, and one of them will be working with us to generate sample data simulating a virtual company"(Network, March 13, 2002).*

Oracle – *"More companies in northeast Ohio use Oracle as compared to SAP. Students with Oracle skills would find it easier to find jobs in the area. (Additionally), more expertise is available for Oracle compared to SAP in the northeast Ohio area" (Network, March 13, 2002).*

Colleges of business may also feel pressure to introduce these systems to students in response to curriculum guide suggestions. Examples of sources of structure are detailed curriculum guides for computer science (Lidtke and Stokes, 1999) and information systems (Gorgone et al., 2000). Additionally, there are documented industry needs for trained graduates and calls for focused ERP research such as those driving vendor alliance programs. Structures derived from regional or national factors should be considered in evaluating the use of ERP systems in the classroom.

3.3 Technology Infrastructure

ERP systems must have a robust infrastructure, which requires a significant commitment of academic resources (Becerra-Fernandez et al., 2000; Watson and Schneider, 1999). These systems typically cannot be implemented without external support. While industry may facilitate appropriation through donated services, additional costs (such as instructor time for in-house support) may still exist, as the following observations highlight:

1) *Software* -"All the suppliers offered to provide it for free or almost free, including the installation, BUT with minimal support commitment. They wanted to charge for the support" (Network, March 13, 2002).
2) *Hardware* – "You need a strong computer host-server, which can support (via networking) a class of computers. You need a lot of memory, disk space, and an unloaded computer network"(Network, March 13, 2002).
3) Operations - *"You can provide a faculty person release time to take care of technology" (Network, March 13, 2002).*

Academics have applied various strategies to successfully address technological hurdles, as indicated by the following list serve comments:

1) Coincide with Operations Software – "*One of the reasons we picked SAP is because our university actually uses SAP to run its operations. Having the experienced SAP staff on the administration side of the university has been a tremendous plus in resolving some of the problems that arise from time to time" (Network, March 13, 2002).*
2) Take Advantage of Hosting Option - "*We implemented SAP here, and have had moderate trouble keeping it up and tuned properly. We are seriously considering taking advantage of the 'hosting' option, whereby for 8,000 extra dollars, we get access to a remote system that is administered by one of the universities designated by SAP as 'resource centers'. I would strongly suggest looking into this option" (Network, March 13, 2002).*

3.4 Educational Organizational Structure

The general role of the ERP in business curricula is manifested by the organization of the college and its departments, and by the high-level appropriation decisions reached by academic stakeholders. The educational organization will affect the process thus:

"Faculty evaluating the implementation of an ERP system such as SAP, PeopleSoft, Oracle or Baan must first look at their school's mission and current pedagogy. To really take full advantage of the enterprise resource planning concept, significant curriculum changes would probably be necessary" (Serve, 1999).

Colleges of business must also decide which departments may benefit from the utilization of ERP systems. Some schools indicated utilization strictly in accounting or information systems, while others indicated a more expansive presence into economics, marketing and management departments.

Academics with various perspectives may be engaged in the decision process. Interview comments from academics indicate that organizing for ERP systems use can be a political process, with varying levels of consensus and uncertainty affecting the appropriation process.

3.5 Collaboration Structure

"The very nature of the work has forced us to work closely with the whole SAP community, the company, the partners, and customers to establish educational needs and modes of delivery" (Serve, 1999).

> "To get to this stage, we needed both: Oracle support and our university internal support" (Network, March 13, 2002).

Academic statements such as the ones above attest to the fact that the appropriation of ERP systems in colleges of business is a joint effort that forms a collaborative system between academics and industry vendors. This collaborative system is not a recognized organization, but a structured social practice of interdependence that has broad spatial and temporal extensions (Giddens, 1982). Implied dynamic rules guide the appropriation of ERP systems in colleges of business, as well as the collaborative system created between industry and academia.

Vendors may readily supply existing resource materials to colleges, but their role may not include customizing or developing resources to suit colleges' educational needs. One academic indicated that, even though a vendor provided a reasonably robust training database, it was necessary to create additional data to suit the needs of lesson plans. Representations of other implied social practices may be found in documents such as curriculum guides that indicate industry participation in the collegiate study of ERP systems concepts (Gorgone et al., 2000; Mulder et al., 1999). The nature of the aforementioned alliances affects the ERP appropriation process.

Discussion lists indicate that collaborations last throughout the life of an ERP system's use. Several academics highlighted the necessity for on-going support for technical as well as inspirational matters to convey skills and concepts from software vendors. Academics indicated that their bond with software vendors might become stronger the longer ERP systems are used in the classroom:

"We are still in the middle of this, and will be forever. We will need to build much closer links with industry, and have had great support from the whole SAP community in course development and delivery" (Serve, 1999).

Tensions due to the varying social practices of academic and industrial collaborators may exist, as each tries to resolve levels of responsibility, focus (rote versus integrated learning), and independence issues (Wohlin and Regnell, 1999). Based on experience gleaned from case studies, structural success factors include a central coordination point, the right mix of knowledge and experience, cooperative planning and scheduling, flexibility to change curricula, communication to build teamwork, and balance to maintain objectivity (Powell et al., 1997).

4. APPROPRIATION PATTERNS

Our proposed model recognizes that appropriation may be best understood if expressed in functional terms - namely, in terms of what the decision makers involved in the deployment process do. Decisions and actions pertaining to classroom instruction are represented in this framework by the educational process and degree of technological faithfulness, which, in the AST framework, are referred to as appropriation moves. Appropriation moves performed by actors indicate the degree of faithfulness and consensus among stakeholders regarding the way in which the technology is to be deployed (DeSanctis and Poole, 1994).

4.1 Faithfulness

Diversity in appropriation moves may exist due to varying degrees of educational "best practices" or "spirit" embodied by the technology and by the ERP system vendor's

appropriation moves (i.e., does the vendor "speak" directly to educational use in terms of marketing, education materials, etc.). Faithfulness refers to the degree of congruence between the spirit of the ERP and the appropriation moves. For example, when technology does not embody educational best practices, the educational institution may customize an ERP, create targeted simulations, or create educational data sets (see Volkoff, 2003, for a case study on configuring an ERP System). These efforts may be required to "work around" the innate business-oriented structure of the ERP specifically to meet educational needs. The extent of the required "work around" provides an indication of the level of faithfulness. Since colleges of business have different learning objectives for ERP utilization, diverse appropriation moves may indicate different levels of faithfulness at various colleges.

4.2 Educational Processes as Innovation Configurations

Diversity in appropriation moves may also exist due to variances in educational processes. The educational process addresses which materials and teacher-student behaviors (teaching models) are implemented. One example of an educational process is the case-based learning approach for ERP systems development in undergraduate classes (Stewart and Rosemann, 2001). Another example is the integration of vendor training materials into an existing college course (SAP Solutions, 2000). The following quotes indicate the existence of variances in appropriation patterns among colleges of business:

1) *Minimal Use* - "I have a case study (Wizard Confectionary) which I use as a basis for parts of the course. We are developing, in the next few months, some 2-hour practical sessions, which are aimed at getting business students to play with SAP under controlled conditions. We will probably make this available on the Web server" (Serve, 1999).
2) *Moderate Use* - "We had a three week hands-on period, including using some CBT courses on SAP as well as SAP itself in our ACELAB" (Serve, 1999).
3) *Maximum Use* - "I divided the class into functional teams and set them loose with JDE. I literally told them to do research on how their functional area should be run, then tried to discover if they could make JDE fit the bill… I've also added the design of an executive interface for the functional area, and the students are going to attempt to create it using the JDE tool kit that enables their 'Idea to Action' concept" (Serve, 1999).

AST acknowledges that there would be an evolution in the decisions made related to faithfulness and educational process issues over the course of ERP systems use in the curricula. However, AST does not specifically address the educational environment, nor does it focus on appropriation patterns, which is where CBAM is useful. CBAM recognizes that "routinized" reproduction of behaviors in the use of technology in education (appropriation moves) forms appropriation patterns (referred to as configuration patterns in the CBAM literature) which tend to be exhibited over a certain period.

Originally proposed by Hall et al. (1973), CBAM represents a technology change model within the educational environment that specifies diagnostic (i.e., measurable via established protocols) dimensions of stages of concern, levels of use**,** and innovation configurations. Essentially, CBAM focuses on the "homeostatic" periods of technology appropriation. It is these sustained appropriation patterns of behavior that provide an opportunity for measurement via the CBAM protocols, as well as subsequent hypothesis testing, allowing us to gain insights needed to develop diagnostic tools and prescriptions for success in the classroom, and to further theory development for educational research.

Innovation configurations (appropriation patterns) are defined by the combination of material, teacher behavior, and student activity (the learning process) used with an ERP system. Configuration matrices are used in CBAM to specify and categorize various appropriation patterns (Heck et al., 1981). These configuration matrices may be used when innovating with enterprise systems in higher education. Specifically, configuration matrices can be used for several purposes, including information dissemination, evaluation, staff development, and research on educational methods (Heck et al., 1981). Configuration matrices can be used to communicate and describe the operational pattern of the innovation, which enables instructors to envision the philosophy and expectations of systems use in the learning process. To evaluate the implementation of an enterprise system in the classroom, a baseline is required for assessing needs, identifying impediments to deeper implementation, and to support requests for funding and resources. Configuration matrices are useful for maintaining a record of instructor activities and for the identification of areas in which additional instructor training may be required. In a research context, configuration matrices can be used to set baselines that are used in comparison to experimental innovation configurations used by treatment groups. Thus, the configuration matrix is a tool for ERP systems practitioners and researchers who evaluate the effectiveness of instructional methods (Heck et al., 1981).

CBAM provides an interview-based protocol guideline, which can be used in an exploratory process to discover and describe the basic components of the specific technology behavior and activities, and to identify functional uses within the educational context (Heck et al., 1981). This appropriation matrix provides a baseline for discerning appropriation patterns (e.g., by analyzing a sample of completed matrices to determine patterns) and for examining the relationships between particular appropriation patterns and outcomes, given certain structural constraints and desired level of use. Institutional behaviors regarding each component of the specified technology are typified by their "highest" level of functional use behavior. Once plausible configuration patterns are identified, a department's level of appropriation

on the matrix can be compared with other alternatives, over time, or with the levels of other colleges. To our knowledge, no such matrix pertaining to ERP systems used in colleges of business exists.

One emerging model for integrating enterprise systems into university curricula focuses on two dimensions: breadth and depth (Rosemann and Watson, 2002). Breadth refers to how comprehensively these highly complex enterprise systems are used in the classroom, and range from a focus on a small set of selected transactions to the use of entire modules (financial accounting, materials management, etc.) and their interdependent relationships within the system. The breath dimension has been categorized into four levels: transaction, module, enterprise and cross-enterprise (Rosemann and Watson, 2002). The depth dimension can be divided into three major categories: process-oriented, applications development, and technical administration (Rosemann and Watson, 2002). The combination of the dimensions of depth and breath, organized into a matrix format, has been used to propose a set of learning outcomes for enterprise systems education. The educational techniques suggested for achieving these learning outcomes range from simple lectures to more complex hands-on experience with ERP systems. The complexity of enterprise systems provides many roles they can assume in the classroom, including those of repository, simulation tool, modeling tool, implementation tool, development environment, and administrator environment (Rosemann and Watson, 2002).

We provide a speculative example (Table 1) of a limited portion of a configuration matrix for an "educational" ERP system based upon triangulating the data sources used in model development (list serve comments, past literature, action research, and curriculum guides). The matrix identifies the basic components of the innovation (listed down the row) and the functional usage (listed across the column). Within each cell, variations are identified by relating each component to its functional usage. The matrix identifies the unique appropriation pattern of component functional usage that exists (Mills, 2002) in a particular ERP implementation. Various configurations of an innovation may exist in the ERP educational context. We believe the various configurations of the ERP educational context can be directly related to the learning objectives categorized by the depth and breadth concepts proposed by Rosemann and Watson (2002). Table 1 augments the depth and breadth model by providing a tool that specifies how a learning objective will be met in a specific learning context.

Table 1. Excerpts from a Possible Configuration Matrix for College of Business ERP Appropriation (Generic Learning Objective)

	Maximum	**Moderate**	**Minimal**	**No Use**
Module coverage	Use most modules across curricula	Expose students to two or more complex modules across 1-3 courses	Confine exposure to one set of modules (e.g., financial modules)	No specific module coverage, with general concepts only addressed
Extent of hands-on coverage	Across courses	Throughout one course	2-3 weeks of courses	None
Facilitate student access to the technology	24/7 access, (e.g., online)	Computer lab and classroom access	Classroom access	No direct student access
Reporting	Design and develop customized reports	Utilize standard system options to create reports	Review output reports	No exposure to reporting functionality
Integrate technology-based activities into course activities	Large-scale (e.g., semester-long project) using ERP system	Discreet assignments during course of semester	Hands-on classroom exercise	No specifically required activity

Successful innovation configurations are defined as those that produce the desired outcomes. The objective for the college of business deploying an ERP in the classroom is to identify a suitable appropriation pattern, given the desired outcome objectives, level of use, and structural profile. In essence, an ideal appropriation pattern may be thought of as "situated best practices" for the educational setting. The current or planned appropriation pattern can be compared to other patterns that seem to "work," given the structural constraints and the desired level of use.

To "calibrate," educators may adjust educational methods, change the degree of system faithfulness, develop course content, and create or procure course materials. This statement also implies that, given a specific structure profile, as the ERP user progresses to more advanced levels of use of the system, a different and more complex appropriation pattern ought to evolve.

5. MODERATION OF THE STRUCTURE PROFILE BY LEVEL OF USE

Since the literature infers that ERP systems will serve some educational units better than others (Becerra-Fernandez et al., 2000; Watson et al., 1999), our model proposes that levels of use will moderate the effects of structure profiles

on appropriation patterns. We propose that the level of use is a moderator rather than a direct antecedent (mediator) to appropriation patterns, as not all levels of use may be viable, given unique structural constraints.

"Then, there is the issue of what you want to do with them (ERP systems) in the classroom, both initially and in the future. If all you will be doing is just an intro to Enterprise Systems, then your evaluation factors would be different than if you would be using this in other courses" (Network, March 13, 2002).

Level of use is an integral CBAM construct that addresses behaviors that take place in relation to the innovation (ERP system). These behaviors are initiated by outcome feedback loops. In the past, this construct had been measured dichotomously as either use or non-use of the innovation. However, due to information loss, dichotomous measurements neglect critical information. Consequently, several levels of use have been identified within CBAM in order to better measure this construct. CBAM provides protocols for contextual specifications of levels of use (Loucks et al., 1976; Hord et al., 1987). Previously used levels that may apply to the context at hand include non-use (no interest; no action), awareness/exploration (initiative to learn more), integration/mechanical (making changes to better organize innovation), integration (routine use with few or no changes), refinement (changes to improve outcomes), expansion (increasing scope of use), and renewal (seeking alternatives to the established use) (Hall and Hord, 1987; Hord et al., 1987).

6. OUTCOMES

Within AST, the outcomes of user action are both a structure and a structuring process that can identify the conditions for the continued deployment of the technology (Shotter, 1983). Therefore, the outcomes of ERP deployment in colleges of business are a result of both structure and of appropriation moves, both of which determine the conditions for the continued deployment of the technology. Outcomes may be at the individual (e.g., instructor advancement), institutional (e.g., new enhanced resources available), or even societal (e.g., better-trained work pool) levels.

Industry aims to benefit from the use of ERP systems in business education through improved public relations, a better-trained work pool (which can lead to savings of time and money), and business growth resulting from product and company exposure (Mead et al., 1999; Beckman et al., 1997). Colleges of business aim to better educate students and make them more employable. Direct educational benefits such as learning a new technology, increased student job skills, enhanced resources, and instructor advancement may result from the innovation configuration. Additionally, some educators hope students can improve logic and analytical skills as a result of navigating these complex systems:

"The initial benefits that I have seen are that the students become both frustrated with the complexity of an ERP package, yet manage to learn how to navigate it. I truly believe many of them will face similar challenges in their working environments, and the second time they're thrown in will be much easier than the first" (Serve, 1999).

Appropriation patterns affect instructor attitudes toward the industrial/academic collaboration and appropriation processes - a social outcome. These attitudes would likely cause changes in the appropriation over time. These attitudes are synonymous with the measurable "stages of concern" dimension of CBAM (Hall and Hord, 1987). Since human actors play a key role in moderating any change process, the concerns of the users/instructors toward the appropriation is a measurable outcome affecting the model.

The main idea of ERP appropriation is to achieve mutually beneficial joint outcomes for the academic institution and the ERP vendor. However, actual outcomes derived from ERP systems use in the educational process may not be seen as desirable to both industry and academic stakeholders, in which case disruptions in collaboration structures may result. Likewise, each educator's specific goals for appropriation may be incongruent with those of other institutional colleagues, and may thus disrupt the organizational/internal structure.

"The faculty involved in the project are evaluating the students' level of performance, and we are getting some conflicting results. Some believe the project is working very well, others are debating the pedagogical issues related to using ERP… I personally believe that students will benefit from possessing a fundamental knowledge of ERP systems and business processes. However, I am not yet convinced that SAP R/3 is necessarily the best route to accomplish that objective" (Serve, 1999).

7. FEEDBACK LOOPS

Since the change process is in a constant state of evolution, our integrated model does not end with outcomes. CBAM recognizes feedback loops (manifested through probing and interventions) that will either sustain continued patterns enacted in routine episodes or eventually propel "episodes of intensive adaptive activity" (Tyre et al., 1996). Structure profile and level of use are relatively constant over a certain period, but then go through a period of change after some probing and intervention by the change facilitators. The new structure profile and/or level of use then move(s) towards equilibrium. Each change period is sparked by the observable benefits (or lack thereof) derived from the specific appropriation pattern. The nature of academic calendars would reinforce this change pattern.

Even when a college of business is achieving its desired educational outcomes, academic institutions should continually assess feedback to determine whether current appropriation patterns work, and whether they are likely to continue to work, given future goals and environmental

conditions. Adjustments to the level of use or structure may be needed. In any appropriation, it is a major responsibility of change facilitators (senior faculty, department chair, dean) to continuously probe and intervene in the process at key decision points (Hall and Hord, 1987).

Another source of feedback is from the instructor attitudes (synonymous with CBAM's stages of concern) towards the appropriation. Seven stages of concern have been identified and measured in the literature. These range from early user-focused to task-focused to impact-focused (Hall and Hord, 1987). It seems that, as the stages of concern for an innovation rise over time, so do the levels of use. Thus, for appropriate interventions, ERP systems change facilitators need to understand the types of users (i.e., instructors) with whom they are dealing, and know the user's stage of concern. As ERP systems users perceive more benefits of use, the aforementioned rise should also be reflected through increased levels of use. As the levels of use rise, the innovation configuration pattern may require change to achieve positive outcomes.

8. DISCUSSION: SYNTHESIS OF A COMPLETE MODEL

The integration of key constructs and relationships from adaptive structuration theory into the ERP appropriation process in the framework pertaining to colleges of business provides a means to recognize the structures (e.g., nature of AIT, external environmental structure, structure of the collaboration, etc.) that can affect the appropriation process, but which can also be changed by the outcomes of appropriation. Likewise, AST-related constructs recognize that the degree of technology appropriation for its intended purpose can affect outcomes and ultimately fuel a change process.

The integration of the key constructs (i.e., levels of use, configuration pattern, and stages of concern) from the concerns-based adoption model into our ERP framework provides a mechanism for defining routine episodes of ERP appropriation in colleges of business. The protocols associated with stages of concern, levels of use, and innovation configurations can be used to provide feedback to change facilitators, who may choose to maintain the status quo or facilitate change by probing stakeholders and intervening to facilitate success. These constructs and their associated assessment instruments provide tools for technology innovation researchers engaged in hypothesis testing, and for teachers engaged in planning and assessing ERP systems use in the classroom.

The integration of elements of these theories into a framework explaining the ERP appropriation process in colleges of business facilitates measurement and provides a more specific means of understanding the antecedents to positive outcomes. The complete integrated model is presented in Figure 2.

The relationships depicted in this model are captured in the following propositions:

P1 – In the ERP appropriation process, the level of use exhibited by the users will moderate the structure profile's effects on the resulting appropriation pattern.

As inferred from the list serve comments, and as identified by Rosemann and Watson (2002), there is a wide range of levels of use which an institution or instructor may implement when working with enterprise systems. Understanding the relationships among the levels of systems use, the learning processes in the classroom, and the variables within the structure profiles would be beneficial to stakeholders. Specifically, an increased understanding of the effects of technology and the organizational resource decisions on the educational process can be achieved by testing this proposition in various environments.

P2 – In ERP appropriation, the success of various joint outcomes involving instructor attitudes and resource benefits is related to the propriety of the appropriation pattern (degree of faithfulness and innovation configuration).

An understanding of the impact of adopting increasingly complex enterprise systems in the college classroom as it relates to the various outcome variables identified is essential for the long-term viability of these costly, complex systems in the classroom. Knowledge of the phenomenon of adopting AITs (particularly, ERPs) into colleges of business will aid instructors, administrators and vendors. The implementation of configuration matrices, as suggested in this paper, provides a mechanism for operationalizing the innovation configuration needed to evaluate the effect of various appropriation patterns on outcomes.

P3 – As a result of probing and intervention, the outcomes derived from the ERP appropriation will affect the level of use of the ERP system.

1) ***Positive outcomes will lead to more advanced innovation configuration patterns.***
2) ***Negative outcomes will lead to less advanced innovation configuration patterns.***

Solicitation and understanding of the feedback resulting from the outcomes associated with enterprise systems use in the college classroom will aid instructors in adapting learning and teaching techniques in the classroom equipped with enterprise systems. The establishment of baseline and follow-on configuration matrices can be used to measure and evaluate changes in appropriation pattern complexity.

P4 – As a result of probing and intervention, over time, positive outcomes derived from the ERP appropriation will lead to more supportive structure profiles.

An understanding of how various outcome variables affect the changes in structure profile variables is valuable to

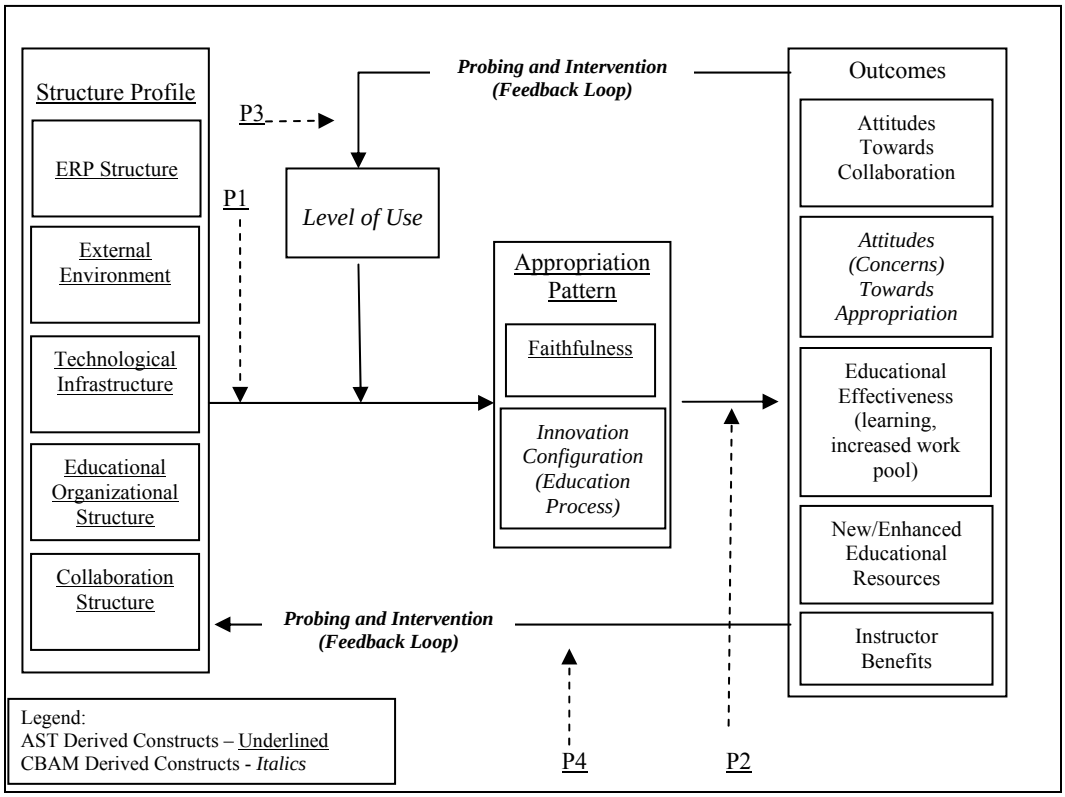

Figure 2. The Full Integrated Model for ERP Systems Appropriation in Academe – Constructs and Sub-Constructs

instructors, administrators and vendors. This understanding would support decision-making concerning the adjustment of resources required for continued enterprise systems use in college classrooms.

If the benefits of the proposed model are to be realized, the above propositions provide a directed call for further work. Future research is needed to further specify these propositions for hypothesis testing. The two-dimensional matrix of learning objectives in the context of enterprise systems education (Rosemann and Watson, 2002) provides a set of objectives ranging, on the diagonal, from basic knowledge of simple process-oriented transactions to the complex evaluation of B2B protocol appropriateness for different business scenarios. These learning objectives should be used as the basis for operationalizing the proposed model for evaluation. Academic-industrial collaborations such as the enterprise systems university alliance programs provide an environment in which evaluations and assessments of the model in various cultural environments may be conducted. The integration of the CBAM methodology provides a proven means of operationalizing the measurement of key aspects of innovation in the educational environment.

The next order of business is to assess the validity of the existing CBAM protocols within the domain of ERP systems appropriation in colleges of business to discern and describe context-specific levels of use, configuration matrices, and stages of concern. The CBAM literature indicates that this specification may best be done via directed field studies, ideally across various institutions, through a set of protocols. This method has been proven in other academic environments (Hall et al., 1977; Heck et al., 1981; Loucks et al., 1976), but has not yet been used to study college-level enterprise systems education. The specification of these constructs provides measures that can be utilized with other measures adapted from other sources. The information systems literature can provide measures for appropriation and technology infrastructure, while the management and marketing literature have measures for external structure, and the educational literature has measures for the remaining constructs. These measures can subsequently be developed into pilot survey instruments used with enterprise systems education, and can be refined for future hypothesis testing.

9. CONCLUSIONS

Academic departments look to industry for support and guidance when introducing business students to the technological knowledge requirements they will face in the workplace. Industry has indicated that exposure to ERP systems should be considered in updated business curricula. Currently, however, there is no "best" way to appropriate ERP systems in education.

The theoretical framework presented in this treatise

provides a foundation on which an understanding of the appropriation process may be based. The integration of the AST and CBAM models into a single framework is relevant to the assessment of ERP systems appropriations in educational environments. The implications of the integrated model are that:

- Routine appropriation moves, forming an appropriation pattern;
- As outcomes are experienced, appropriation patterns are adjusted if significant changes in future outcomes are desired, or if changes in underlying structures are introduced; and
- The change process recycles itself, forms a new structure profile, and begins again.

If an adaptation in systems appropriation does not occur as indicated by a modified structural profile, unexpected and undesired outcomes may result.

Academics who currently implement ERP-related programs can use the framework to identify key factors needed to manage the planning, implementation, and assessment of educational programs for ERP systems. Variables in the model can be used as the basis for discussion with ERP vendors, support personnel, and instructors. The creation of customized configuration matrices can foster discussion and aid in generating ideas about curricula and course development. As the program matures, the framework can aid in the assessment process, and may trigger subsequent modifications to courses. Future endeavors using the proposed model can aid colleges of business in selecting appropriate configurations for existing structures and desired levels of use.

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