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■ *Notes and Insights*

# Integrating Systems Thinking into IS Education

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## INTRODUCTION

IS failure[1] has been observed and documented in various articles (Barker and Frolick, 2003; Beresford *et al*., 1976; Bostrom and Heinen, 1977; Bussen and Michael, 1997; Heeks, 2002; Kay *et al*., 1999; Kaye, 1990; Keil and Robey, 2001, Mitev, 1994). Many researchers have tried to understand the phenomenon by studying success or failure factors (Birks *et al*., 2003; Peterson *et al*., 2002; Poon and Wagner, 2001; Schmitt and Kozar, 1978; Senn, 1978) with the hope that IS professionals can learn from these lessons (Ginzberg, 1981; Lyytinen and Robey, 1999).

For example, Clemons and Row (1995) found that reasons for BPR failures are unrelated to the technical ability of organizations to implement information systems, but were instead due to the organization's inability to understand its uncertain future strategic needs and its inability to make painful and difficult changes in response to these future strategic needs. Lorenzi and Riley (2003) have shown that reasons for IS failure include problems in communication, complexity, organization, technology, and leadership. They classified IS failure into four major categories: technical shortcomings, project management shortcomings, organizational issues, and the continuing information explosion.

It is our view that we need to investigate the root of the problem of IS failure: IS education. Lyytinen and Robey (1999) noted that IS professionals commonly assume that their biggest challenge is to acquire new technical knowledge, and this is one of the barriers preventing IS professionals from learning from IS failure. A systems view would provide a more useful paradigm to understand IS failure in organizations. They call for reforming IS education to make the learning process effective for IS professionals. In this paper, we argue that the problem with many IS failures comes partly from the lack of systems thinking in the IS curriculum. We suggest the incorporation of a systems thinking component into IS education as a long-term strategy to improve IS professionals' capacity and to deal with the IS failure problem.

The paper is organized in the following manner. We first view IS in organizations as a complex system and IS as an interdisciplinary field. Then we discuss the nature of many current IS curricula focusing on linear thinking and a single perspective. The next section reviews current trends of systems thinking and how they

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[1]In this paper, IS failure is referred to both system failure and project failure, although later in this paper it implies curriculum failure.

can be valuable to IS education in understanding the failure problem. A methodology for incorporating systems thinking into IS education is proposed, and the case of an MIS program at a Vietnamese university is discussed in light of the proposed methodology.

## INFORMATION SYSTEMS AS INTERDISCIPLINARY AND AS COMPLEX SYSTEMS

Information systems by their nature link all organizational disciplines. As information systems do more and reach more users in more locations, they become more complex systems. Ryan (1999) observed: 'every move toward making technology simpler has been matched by a corresponding move toward increased complexity'. The paradox of IS in organizations today is that: 'on the one hand, technology for the business user has become dramatically simpler as end users have been shielded from complexity; on the other hand, the actual development of systems architectures and business solutions has become far more complex' (p. 89). In complex information systems, Chadwick *et al*. (2003) found that it is extremely difficult to produce a user interface that pleases everyone and failure of just one component or administrative procedure can have a catastrophic effect on the availability of the entire system. The complexity of IS and organization interaction depends on the number of tasks and functions of the systems (Smeds, 1988). Understanding the organizational system better should lead to more effective IS design and implementation.

An organizational IS emerges as a complex social system (Land and Hirschheim, 1983; Walsham *et al*., 1988), often in a chaotic state (Dhillon and Ward, 2002); IS emerges as interdisciplinary in nature (Gorgone *et al*., 2002). IS deals not only with engineering and technology but also with organizational and social issues (Lyytinen and Robey, 1999). As technology becomes more and more important and pervasive in business and individual life, IS professionals need to include more and more social aspects in their technical problem solving into the very core of the technical curriculum (Dahlbom and Mathiassen, 1997). Requirements for IS professionals include understanding effective and efficient applications of IT to solve business problems, a firm grasp of business functions, and interpersonal and management skills to work with their functional peers (Gupta and Wachter, 1998). Industry demands IS professionals with knowledge and skills in technology, business operations, management and interpersonal skills (Lee *et al*., 1995). Hirschheim and Klein (2003) claimed four types of knowledge required in the IS field, of which technical knowledge is just one. Similarly, Gorgone *et al*. (2002) gave four main assumptions about the IS profession:

(1) IS professionals must have a broad business and real-world perspective.
(2) IS professionals must have strong analytical and critical thinking skills.
(3) IS professionals must exhibit strong ethical principles and have good interpersonal communication and team skills.
(4) IS professionals must design and implement information technology solutions that enhance organizational performance.

Research has shown that IS practitioners are not satisfied with the quality and skill training of IS graduates (Lee *et al*., 1996). Most employers prefer graduates with high competency in technical skills but often complain that they lack business and interpersonal skills. Many concerns remain with the curriculum (Gupta and Wachter, 1998; Lee *et al*., 1996; Mutch, 1996; Vargo, 1993). Williams and Heinrichs (1993) argued that past and present models tend to organize course content around technologies and methodologies. Thus, they proposed an MIS curriculum modeled on Anthony's pyramid (Anthony, 1965). Their proposed course structure is organized by type of problem: operations, management, and strategic. Lee *et al*. (1996) proposed a market segmentation approach to IS curricula. Gupta and Wachter (1998) proposed a capstone course in the IS curriculum to develop students' abilities and skills needed.

## LINEAR THINKING IN IS EDUCATION

The traditional approach to Management Information Systems (MIS) curricula development is technology-oriented (Lyytinen and Robey, 1999; Romm and Pliskin, 2000; Williams and Heinrichs, 1993). Many IS courses or curricula focus on technical skills (database, telecommunication, programming, etc.) at the expense of analyzing the impact of the technology on organizational structure, work, and people (Gupta and Wachter, 1998) and the connection of IS courses with 'business/management' is tenuous (Mutch, 1996). Thus, many current IS curricula lack the integrative and pragmatic IS education most demanded by business professionals (Burn and Ma, 1997; Gupta and Wachter, 1998; Lee *et al*., 1996, 2002; Zack, 1998). Consequently, IS students are often unable to view the problem of IS development in organizations from a multidisciplinary perspective.

Universities are traditionally organized into disciplines such as natural sciences, social sciences, business studies, etc. (Brewer, 1999). These are further divided into subdisciplines. Sociology, for example, includes psychology, sociology, political science, anthropology, and others. Business studies are divided into accounting, marketing, business administration, management information systems, and others. Currently accepted principles for university management and curricula development were created decades ago, and universities have tended to be closed systems where disciplines are isolated and independent (Takala *et al*., 2001). Consequently, higher education has failed to prepare students to face issues such as social complexity, cultural and economic globalization, and increasing interdependences (Jenlink, 2001). 'Knowledge does not come in pieces: to understand an aspect of [IS] nature is to see it through 'all' the ways of imagery (Churchman, 1971, p. 198). Ackoff (1999b, p. 533) said: 'neither nature nor society is organized as the universities are into disciplines'. The way that universities are organized may create the false impression that the real world is divided into the same parts. This fragmentation has not provided students with a unified view and application of subjects as expected by society (Houseman, 1979).

MIS programs face the same problem: students are required to learn a number of different subjects that are often taught independently. In most MIS programs, students are required to complete a series of technical core courses that exclusively focus on the concepts of a single technology. For example, a computing curriculum (Turner, 1991) proposed 84% of its lecture hours for technical courses and only 8% for non-engineering subjects (e.g., social, ethical, and professional issues). Students may want to broaden their perspectives by taking elective courses such as management or organizational theory. However, taking many different subjects does not necessarily mean that students can develop a holistic view from these subjects that would help them in understanding the complex situation of IS organizational interaction. First, students need to be trained to view a thing from multiple perspectives, and, secondly, they need to learn the systems perspective to see the picture as a whole.

Many IS courses focus on problem solving but they often take a simplistic view of people and organizational contexts. Much of the behavioral research published in IS journals has not been incorporated into typical IS courses or programs. While many technical IS courses are based on design science, research in this field has been limited. Hevner *et al*. (2004) point out five challenges that design science is facing. Two—lack of a cumulative theoretical base; and insufficient sets of constructs, models, methods, and tools for representing the business/technology environments—are particularly relevant to system views.

Single perspective thinking has been ingrained in traditional teaching methods in business schools for a long time. Students of many disciplines are equipped with a toolkit of types of problems with solutions (Gharajedaghi, 1999) and expect them to apply the solutions that they have learned for these kinds of problems in real, complex organization environments. Thinking with a single perspective is associated with linear thinking (Richardson, 1991). In linear thinking, thinkers assume cause and effect are closely linked in time and space. While single perspective thinking is a result of emphasis on specialization, linear thinking results from assumptions that simplify relationships among elements in the system under study.

## SYSTEMS THINKING

A system is a complete entity that consists of two or more parts with relations to each other and to an environment. Systems thinking is based on the systems approach in which the whole is more than the sum of the parts and every part has an effect on the system behavior. In messy environments, many authors (Checkland, 1981; Mitroff and Linstone, 1993; Senge, 1990) have proposed systems thinking as a foundation for problem solving. Systems thinking means seeing things as a whole. Although using the same terminology, different authors approach systems thinking based on different concepts and paradigms. In the remaining section, we focus on three schools of systems thinking among a large number of research and practice streams in systems thinking (Jackson, 2003). Table 1 compares them in terms of paradigm, basic elements, assumptions, strengths, and weaknesses.

*Table 1. Three schools of systems thinking*

| | Senge's systems thinking (Senge, 1990) | Checkland's systems thinking | Mitroff and Linstone's unbounded systems thinking (Mitroff and Linstone, 1993) |
|---|---|---|---|
| Paradigm | System dynamics (Forrester, 1961) | Soft systems (Checkland, 1981) | Multiple perspectives, Singerian inquiring system (Churchman, 1971) |
| Basic elements | Stock and flow, feedback loops, delays, non-linear relationships (system dynamics) Links and loops or causal diagrams and archetypes systems thinking) | Rich picture consists of problem situation, logical and cultural streams; model elements include problem description, root definitions and CATWOE elements, and conceptual models of human activity systems | P, O, and T perspectives: P: personal or individual O: organizational or societal T: Technical A problem should be viewed from the O, P, and T perspectives |
| Assumptions | Things are interconnected in complex patterns that can be captured into a model without loss of relevance | Multiple realities, multiple world views on a problem. Ambiguous goal systems. A problem is managed, not solved | Ill-structured problems can only be understood from multiple perspectives. The process of sweeping-in is converged |
| Strengths | Quantitative simulation with the help of computer models that allow experiment and prediction | Allow seeing a problem from different views that may give insight into understanding the problematic situation. No formal modelling and no computing are needed | Adding the P and O perspective to the T perspective to improve understanding of messy problems |
| Weaknesses | Too much emphasis on the technical perspective that overlooks the cultural and personal perspectives | Qualitative simulation using everyday language and human mental models which may not handle well the complexity of problems in complex systems | Difficult to define precisely the P, O and T perspectives in a real-world situation. Lack of detailed guidelines for implementation |

### Senge's Systems Thinking and System Dynamics

Senge's (1990) systems thinking is based on system dynamics paradigm (Forrester, 1961), in which feedback loops, delays, and non-linear behavior or relationships are emphasized. System dynamics (SD) is a methodology for modeling the structure and behavior of complex systems. It has successfully been applied to solve complex problems in a variety of environments: the world (world dynamics), city (urban dynamics), organizations, groups, and individuals.

Senge's conceptual framework includes a body of knowledge and tools that has been developed to make the full patterns clearer and to help us see how to change them effectively. The important tool of Senge's systems thinking is archetypes, which are the patterns of behaviors of some common social systems. These patterns are based on experiences learned from a great number of system dynamics models. Some interesting archetypes are 'limits to growth', 'shift the burden', 'tragedy of the common', and 'fixes that backfire'. In addition to these archetypes, Forrester (1969) observed that some behaviors of complex systems are counter-intuitive and created some rules of thumb that are helpful for systems thinkers. Some examples are:

- Today's problems come from yesterday's solution.[2]
- The harder you push, the harder the system pushes back.
- Behavior grows better before it grows worse.
- The easy way out usually leads back.

Understanding the organization as a system is crucial to rational design of an IS. What may make sense technically may well work counter-productively in the organizational system.

### Checkland's Soft Systems Methodology

Checkland (1981) provided a soft systems approach which tries to build a 'rich picture' of the problem situation from stakeholders' different views. SSM analyzes systems with two streams: logic-driven and culture-driven, which consider the social and political contexts of the problem situation. The logic stream consists of identifying relevant systems, modeling these systems, comparing models and the real world, and determining desirable and feasible changes based on cultural analysis. The interaction of the two streams helps to understand the problem.

Checkland's systems thinking tries to avoid the reductionism that is inherent in natural sciences where analytical methods are dominant. SSM promotes systems thinking as it allows viewing a problem from multiple perspectives and accepting that there are multiple realities for a given problem. Checkland's approach is also similar to Forrester's system dynamics approach in the sense that systems thinking is involved with building conceptual models of the problem that can be compared with the real-world situation. Social systems have ambiguous and indeterminate goals; consequently, no decisions can force the systems to achieve a goal. With the help of qualitative models, problems can be understood; system interventions can be designed to 'solve' problems. The insight provided by this perspective can be instrumental in focusing IS to more effectively support organizations.

### Mitroff and Linstone's Systems Thinking

Mitroff and Linstone (1993) identified the three most typical perspectives to view a messy problem: T is the technical perspective; O is the organizational or societal perspective; and P is the personal or individual perspective. They (Mitroff and Linstone, 1993, p. 98) believed that 'each perspective reveals insights about a problem that are not obtainable in principle from others'.

According to Mitroff and Linstone, there is no neat T perspective methodology for problem solving in messy environments. From the technical perspective (T), traditionally a problem should be formulated objectively and quantitatively, which disregards human and

[2]For example, the structure of disciplines in a university was a solution in the past but may be a problem now.

organizational factors. This perspective tends to produce a solution to a problem that people will eventually resist implementing. Scientists tend to emphasize the technical perspective, while leaders favor the personal perspective, and other stakeholders call for adopting the organizational perspective. In a messy environment, problems can hardly be solved if a single perspective is taken; thus, we need to sweep-in perspectives other than T when structuring problems. There is no limit in the sweeping-in process. 'Every discipline, profession, way of knowing so as to give the broadest possible view of any problem' (Mitroff and Linstone, 1993, p. 109) can be swept in. In this sense, we consider Mitroff and Linstone's Unbounded Systems Thinking (UST) (1993) to offer the broadest form of systems thinking, to see the whole thing from any possible angle.

## INCORPORATING SYSTEMS THINKING INTO IS EDUCATION

IS courses can be classified into three types: technological, supporting (social sciences or business administration), and MIS. Technical courses may include some purely technical courses (such as computer architecture, data structure, and operating systems) that have their origin in computer science and foundation courses (such as database, visual programming, software engineering, system analysis and design) that are supposed to be used in later MIS courses. MIS courses (such as e-commerce, software project management, and decision support systems) are supposed to integrate with knowledge in other related fields. Supporting courses consist of tools and organizational functional courses. Accounting, statistical methods, and quantitative methods are tool courses that can be taught in a conventional manner: lecture, exercises and tests. Social science courses that study the psychology and behavior of individuals and groups can also be taught in conventional manner, but students generally have difficulties in integrating these topics with IS courses if they lack real-life experiences. Also, we maintain that in many IS curricula students are generally lacking systems thinking courses that teach the general picture of management and organizations. In this kind of course, students or participants learn how to generate ideas, to build a theory of their own, and how to test an idea to understand the complex nature of organizations (Lyytine and Robey, 1999).

We propose the incorporation of the systems thinking perspective into IS education in two stages, which could consist of one course each, replacing the current introduction to IS and capstone courses (see Figure 1). In the first stage (multidisciplinary stage), we need to integrate contents of cross-disciplinary subjects of management and organizations into one interdisciplinary course on IS. This course may potentially involve multiple subjects, but emphasis is dependent on course designers. In the second stage (ST framework in IS), we need to integrate systems thinking tools or framework.

As presented earlier, Senge's systems archetypes/Forester's system dynamics, Checkland's SSM, and Mitroff and Linstone's UST are exemplars of such tools or framework. These stages are combined into a methodology for designing IS education. Table 2 describes how each of these approaches could be incorporated into IS curricula.

### Integrating Contents of Cross-Disciplinary Subjects into One Interdisciplinary Course

To provide students with cross-disciplinary contents for the first stage, four general strategies can be adopted: content analysis, combined courses, integrative cases (Michaelsen, 1999), and action research.

In the first strategy (*content analysis*), faculty should attempt to understand other disciplines at a level where they can explain conceptual linkages with the content of other courses. The advantage of this strategy is simplicity, minimal coordination effort, and ease of implementation. The major disadvantage is lack of enthusiasm on the part of students and faculty.

The second strategy (*combined courses*) is using a faculty team to teach multiple cross-disciplinary courses. The advantage is better effect on student

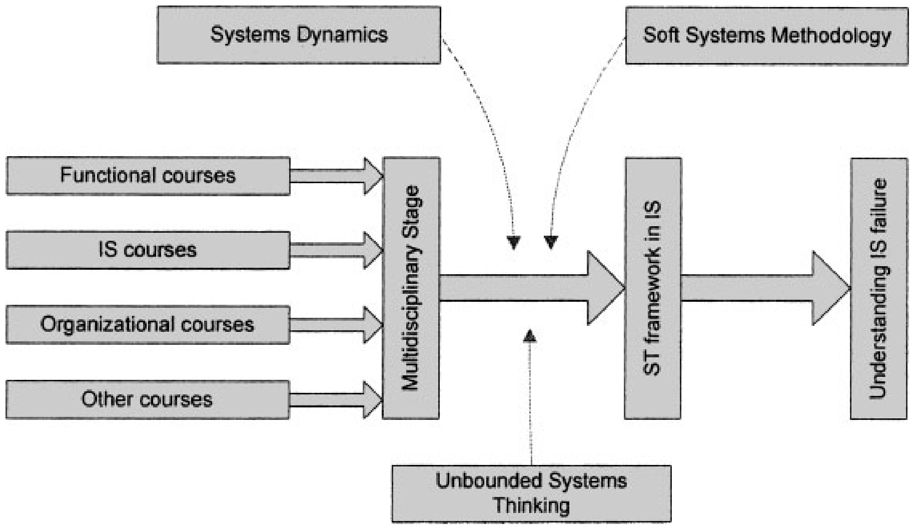


*Figure 1. Incorporating systems thinking into IS education*

learning as a conceptual framework of cross-functional issues is sought via interactions among faculty. Combining courses could create more problems than benefits because it requires a high level of faculty effort for building things from scratch, coordination, and conflict resolution. Students often see more problems in this approach than benefits from seeing the big picture.

The *integrative case approach* is the most common due to its ease of implementation. The main requirement is to design cases so that they can be used across multiple courses. This strategy also requires coordination but significantly less than in combined courses.

The fourth strategy would be applying *action research* in IS education. Action research is 'an iterative process involving researchers and practitioners working together on a particular cycle of activities, including problem diagnosis, action intervention and reflective thinking' (Avison *et al*., 1999, p. 94). A key characteristic of action research is that investigators try to fulfill the needs of their study subjects and, at the same time, generate new knowledge. This method has been successfully used in IS doctoral education (Kock *et al*., 2002), and was successfully adopted at the master's level (Burn and Ma, 1997). At the undergraduate level, a capstone IT course (Gupta and Wachter, 1998) can apply this method to integrate concepts which were previously treated elsewhere in isolation. A growing number of undergraduate IS programs have been adopting such an action-based capstone IS course through which both students and clients get benefits.

*Integrative case study* seems to be the best candidate for teaching cross-disciplinary contents such as IS (Lyytinen and Robey, 1999; Romm and Pliskin, 2000). Case study has been a popular teaching method used extensively at business schools. Learners are often provided a case with a guideline or a framework for discussion. The normal approach to the case method begins with a system description, followed by some guidelines and questions. Participants will be required to design alternative policies and structures. Case studies are often written in a descriptive mode that depends on observation, discussion, and debate. Participants learn through analyzing and discussing the case. Case study methods can enhance learners' mental models by exposing them to realistic or complex environments. Its advantage lies in ability to expose students to real-world and critical issues (Burn and Ma, 1997).

One of the main weaknesses of the case method is that a recommendation for the case can never be tested. As a result, participants' mental models remain biased with untested assumptions or beliefs. Forrester (1969) identified several

Table 2. *Incorporating systems thinking into IS education*

| | Senge's systems thinking (Senge, 1990) | Checkland's systems thinking (Checkland, 1981) | Mitroff and Linstone's unbounded systems thinking (Mitroff and Linstone, 1993) |
|---|---|---|---|
| Potential areas of application | Recognizing patterns of feedback loops that determine IS behavior | Design of support systems | Understanding IS failure |
| | Experiment and prediction of IS dynamics | IS analysis and design | Design of multiple perspective IS (such as ethical IS, political IS) |
| | Project management | Action research | Problem formulation, design of support system |
| | Evaluation of IS implementation | Combining design science and behavioral science in IS (Hevner *et al.*, 2004) | |
| Example works | Causal loop diagram can be used for accessing students' understanding of IS, explaining various components of IS and their interactions (Croasdell *et al.*, 2003) | IS development methods such as MULTIVIEW (Avison *et al.*, 1998) | Managing deployment of new IT projects (Lyneis *et al.*, 2001) |
| | Anticipating the organizational impacts of various IT-related decisions and actions such as outsourcing (McCray and Clark, 1999) | SSM as a framework for BPR (Chan and Choi, 1997) | Framework for ethical DSS design (Chae *et al.*, 2005)<br>New decision-making paradigm for DSS (Courtney, 2001) |

weaknesses of case study method: (i) no quantitative foundation; (ii) some implicit knowledge cannot be made explicit; (iii) dependence on intuitive judgment for policy analysis; and (iv) difficulty to make the dynamic interactions needed to come to conclusions or recommendations. Graham *et al.* (1992) has proposed model-supported case studies to overcome disadvantages of the case study method.

## Integrating Systems Thinking Tools/Frameworks into IS Courses

Aram and Noble (1999) argued that the dominant models of learning and thinking in business schools are appropriate to the stable and predictable aspects of organizational life. For the second stage, the IS curriculum needs to provide IS students with a dynamic picture of IS and the organization and their interactions. System thinking in general and the three schools of system thinking in particular can make significant contributions to IS courses.

Integrating the general idea of systems thinking into IS courses can begin with the most entry-level IS course, which is 'Fundamentals of Information Systems'.[3] This is where business majors (including MIS majors) are exposed to the field of IS and learn the meaning of IS. In this

[3]For this discussion, we refer to Gorgone *et al.*'s (2002) Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems.

sense, this entry-level course would be very critical for reforming MIS education. Based upon many prior IS studies, Hirschheim and Klein (2003) show that there clearly is a problem with non-IS practitioners' (and senior management's) view of IS: they have a narrow, unrealistic image of IS and unrealistic expectations about what IS can and cannot accomplish.[4] Almost three decades ago, IS systems designers' narrow, static, and functionalistic view of IS and organizations was attributed to IS failure (Bostrom and Heinen, 1977). Today this view is still dominant in many IT projects (Markus and Benjamin, 1997). The way the entry-level IS course has been taught at most undergraduate programs can be attributed to such a functionalistic view of IS. The view of IS as complex systems, as we argue from systems thinking, clearly needs to be adopted. Other specific topics in this course as well as advanced IS courses should be taught based on an organic, holistic view of IS. This systems view helps students consider information systems to be more than the sum of their socio-technical parts and to focus on the networks of relationships between the socio-technical parts.

In summary, systems thinking offers an organic, holistic view of IT and allows understanding of complexity, interactions, and change in IS. The three schools of systems thinking in particular can offer useful tools/framework for and make distinct as well as synergistic contributions to IS courses. In general, Senge's thinking/system dynamics serve a tool for explaining and predicting complex systems interactions in various IS contexts (e.g., IS project management, planning, use, and implementation). Checkland's SSM helps students understand the problematic situation correctly and explore the desired goals through the support of information systems. In this sense it can be an important tool for courses related to IS development and the application of emerging, complex technologies which require a significant organizational change.

[4]They also pointed out that there is a significant disconnect between IS practitioners and researchers. The view by practitioners is quite distant from that suggested by IS studies using such theories as structuration theory, actor network theory, institutional theory, and systems thinking.

## ILLUSTRATION: A VIETNAMESE CASE

In this section, we discuss a case in light of the proposed methodology. We analyze the development of the MIS curriculum at Ho Chi Minh City University of Economics (HUE), Vietnam, and offer suggestions for incorporating systems thinking into the curriculum.

### Current MIS Curricula

'Data Processing in Economics' (DPE) was established at HUE in 1978, focusing primarily on mainframe applications. In the early 1980s, the curriculum focused on programming languages, analytical courses, hardware and software, compilers, and operating systems skills (eventually on microcomputers). In 1986, it was renamed 'IT for Management'. Many graduates have become data-processing personnel, programmers, and technicians. In the mid 1990s, the focus shifted towards business and the managerial role of computer-based information systems to support decision-making processes in organizations. To respond to the change, the Ministry of Education and Training (MOET) of Vietnam established a new MIS department within HUE in 2002.

HUE's current MIS curriculum is designed as a semester-based, 4-year program to cover the common knowledge of Business (Accounting, Finance, Economics, Marketing, Management, Business Law, Statistics, Organizational Theory, Structure, and Functions), Knowledge of Information Technology (Computer Systems Hardware, Operating Systems Management, Fundamentals of Programming, Algorithmic Design, Networking (LAN/WAN) and telecommunications), and knowledge and skills related to using a business application development language (Application Development, Client–Server Software Development, Web Page Development, E-Commerce, DB Systems, Software Engineering, Systems Analysis and Design, MIS Project Management).

Business functional courses are provided to MIS students by other departments of HUE. They are designed to provide students with various concepts of how typical business functions operate so that MIS students will be able to identify problems or opportunities that information technology or MIS can support. These functional courses would be taught the same way even if no MIS students were enrolled in them. In reality, they have been taught as if all of the students would ultimately work in these functional areas. There is no cooperation between the MIS department and other departments on the objectives, content, and structure of these functional courses. When examining the syllabi of various courses, we find that the objective often are to achieve technical knowledge and skills related to some technologies without relating these technologies to supporting business and organization functional decisions. Weak linkages also occur between technology courses. In design, technology courses are linked in sequence. In reality, many technology courses are taught independently of each other (see Table 3).

HUE's current MIS curriculum is lacking interdisciplinarity and systems thinking content for several reasons. First, HUE's current MIS curriculum is organized around information technology as a traditional curriculum (Williams and Heinrichs, 1993). Students and faculty members are primarily concerned with producing optimized solutions for organizations using new technologies. Little concern is given to business and organizational problem contexts. Second, as compared to the current model curriculum developed by leading experts in the field (Gorgone *et al*., 2002), HUE's MIS curriculum lacks coverage of Interpersonal Skills, Teamwork, and Communications Skills, which are found to be the most important MIS skills by both MIS practitioners and MIS academics (Lee *et al*., 2002; Todd *et al*., 1995). In no course is the concept of systems thinking introduced. Third, HUE is large and has an inflexible departmental structure, which creates difficulty in coordination with other business departments within HUE in providing MIS students with knowledge in business functional areas. Traditional Vietnamese universities are built on the concept of specialization. Departments are traditionally centers of specialized knowledge. Interdisciplinary programs like MIS are a new concept and not widely accepted in many Vietnamese universities. A department is not supposed to know about other departments' fields and vice versa. In this environment, the university's top management and departments at HUE generally do not support interdisciplinary activity. Departmental structure favors individual achievement, while interdisciplinary curricula demand collaboration.

**Incorporating Systems Thinking**

- In HUE's curriculum, purely technical courses include computer architecture, data structure, operating systems, and fundamentals of computer programming. Currently most of these courses are taught independently of all other courses. Potential changes for these technical courses are to indicate in each course how the knowledge of one course can be used (or linked) in other courses or to design data structure for business problems in accounting, marketing or economics. In an extreme case, it is possible that these courses could be combined into a unified course that provides MIS students with the basic concepts in computer systems. The purposes of these changes are to create an integration among these technical courses and to initiate a link of IT with business problems. Note that the former purpose is more important than the latter for the courses of this type. Suggested strategies for implementing these changes are content analysis and combined courses.
- Foundation courses in HUE's curriculum include database, database systems, object-oriented programming, visual programming, and web programming and web database application. Currently most of these courses are taught independently of all other courses; no connection is found among them or with supposedly related courses. Potential changes can be made in two directions: to create the links among them as well as with previous purely technical courses and later MIS courses; and to start attacking real business and organizational problems. The former direction is intended to provide students with a rather complete whole view of technical

Table 3. *Summary of HUE MIS curricula*

| Course | Current characteristics | Semester | Potential changes |
|---|---|---|---|
| Computer Architecture | Purely technical course<br>No connection with other courses | 2 | For interdisciplinary stage:<br>• Indicate how the knowledge of one course can be used in other courses |
| Fundamentals of Computer Programming | Purely technical course | 2 | • Initiate a link of IT to business problems (e.g., design data structure for business problems in accounting, marketing or economics) |
| Data Structure | Purely technical course<br>No connection with other technical and managerial courses | 3 | Suggested strategies for interdisciplinary implementation:<br>• Content analysis<br>• Combined courses |
| Operating Systems | Purely technical course | 3 | |
| Object-Oriented Programming | Foundation/technical course | 4 | For interdisciplinary stage:<br>• Technical integration among foundation courses and with previous and later MIS courses |
| Data Communications and Networks I and II (Advanced) | Purely technical courses<br>Taught independently of related courses | 5 and 6 | • Aware of the complexity of real IS problems by being involved with real business and organizational problems/projects |
| Database Systems I and II (Advanced) | Taught independently of all other courses<br>Introduced current technologies in database systems | 5 and 6 | |
| Database I and II (Advanced issues in database) | Foundation/technical course<br>Taught independently of all other courses | 5 | Suggested strategies for interdisciplinary implementation:<br>• Combined courses<br>• Integrative cases |
| Visual Programming | Foundation/technical course<br>Taught independently of all other courses | 5 | |
| Web Programming and Web Database Application | No connection with related courses such as E-commerce, software project management, system analysis and design | 7 | |
| Decision Support Systems (DSS) | Introduced DSS tools<br>Use the knowledge of database and programming courses | 6 | For interdisciplinary stage:<br>• Technical integration among MIS courses and with previous courses and other business and organizational courses<br>• Broader approaches to IS problems in organization and society |

*Table 3. Continued*

| Course | Current characteristics | Semester | Potential changes |
|---|---|---|---|
| Software Engineering | Taught independently of all other courses | 6 | For systems thinking in IS stage:<br>• 'Sweep' in systems thinking frameworks, models or research results into current MIS courses<br>• Design new contents of how ST can be integrated into MIS contents<br>Suggested strategies:<br>• Combined courses<br>• Integrative cases<br>• Action research |
| Systems Analysis and Design | Taught after programming, database, and data structure courses. Related to some managerial functions, but mainly at operational levels Lacking of ST framework | 7 | |
| Software Project Management | No connection with software project courses such as e-commerce website development, system analysis and design | 7 | |
| Electronic Commerce | Managerial approach Lacking of ST contents No connection with technical courses | 7 | |

courses to create a technical integration of IS knowledge, while the latter one prepares them for dealing with personal and organizational issues.

The purposes of these changes are to create a strong technical foundation of IS knowledge and to make students aware of the complexity of real IS problems. These two objectives are equally important and should be emphasized in all courses. Some examples of technical integration are to combine the data communication and network course, and the web programming and web database application course, with the e-commerce course; to design programming projects for business problems in accounting, marketing, or economics; to integrate design of databases with projects from the systems analysis course or to require database design for some non-MIS courses. For the second direction, exercises of database design, project planning, system analysis and design, etc. should be directed to real business or organizational situations. Suggested strategies for implementation are combined courses and integrative cases.

- MIS courses in HUE's curriculum include e-commerce, software project management, decision support systems, software engineering, and system analysis and design. Knowledge in these courses; is interdisciplinary in nature. However, these courses are taught independently of all other courses; although some individual efforts trying to integrate MIS courses exist, they are rare. The major weaknesses are low level of integration and lack of an ST framework. Potential changes for MIS courses can be made in two directions: to create links among themselves as well as with previous foundation courses and other business and organizational courses; and to present an ST framework for understanding IS problems in real organizations.

The purposes of these changes are to create an integration within MIS courses as well as with non-MIS courses and to provide students with broader approaches to IS problems in organization and society. Changes in these MIS courses are most important in improving the IS failure phenomenon. Examples of the changes for the first objective are to require design of DSS tools to support managerial/functional decisions; to integrate DSS with management science courses; to integrate design of software engineering with projects from the systems analysis course; software project management; to require system design for another functional area of business (e.g., marketing) and to make this requirement for MIS students in non-MIS (e.g., marketing) classes; to require a major software project from other courses such as system analysis and design, and e-commercial website development. Suggested strategies for implementing this change in direction are combined courses and integrative cases.

Changes in the second direction are more complex and can be made in two different ways. The simple way is to 'sweep in' (Mitroff and Linstone's UST) systems thinking frameworks, models or research results into current MIS courses. For example, in DSS or system analysis and design courses, Checkland's SMM and Avison's MULTIVIEW can be introduced to analyze the cultural issues of IS; UST can be introduced to study different perspectives in IS development. In IS project management courses, systems thinking/system dynamics can be used to understand the dynamics of IS projects (Pfahl *et al*., 2004) to include IS failure. The more radical way is to design new contents of how ST can be integrated into MIS contents. For example, at the start of an IS project, stakeholder analysis should be carried out to understand potential impacts of different stakeholder views on the IS project. By recognizing the roles of all stakeholders and understanding where the breakdown links occur, IS professionals can learn to offer structures/mechanisms to mitigate the likelihood of similar breakdown problems (Murray, 2001). ST is used to predict the dynamics the interaction among the stakeholders' views and behaviors over time. For the latter, it is necessary to develop new curricula (course objectives, materials, and faculty) almost from scratch. Suggestions for implementing this change direction are combined courses, integrative cases, and action research.

## CONCLUSION

Single perspective and functional thinking has been dominated in traditional business programs including MIS for years. This thinking style originated in the fields of engineering and natural sciences has been successful in business and management schools in the 1960s, 1970s, and 1980s. In the 21st century, however, business environments have become more dynamic and messier than ever, defeating traditional thinking in problem solving. Students in business schools should be prepared for such an environment.

Systems thinking emerges as an important tool to tackle 'messy problems' (Ackoff, 1999a) in today's dynamic environment. There are different schools of systems thinking based on different concepts and paradigms; but they all refer to seeing things as a whole—holism—within a framework that helps IS professionals deal with complexity in a holistic way. Systems thinking calls for an integrative, multiple-perspective approach to the problematic situation. This article proposed a two-stage methodology for integrating systems thinking into IS education and described what IS courses with systems thinking look like and how one can begin including it in IS curriculum. Traditional thinking modes emphasize the rational, linear, efficient, and functionalistic features while new ways of thinking should promote flexible modes such as interpretive, non-linear, systemic, and creative thinking.

It is very important to reform IS education in the direction that emphasizes not only information technology content but also organizational problem solving (Lyytinen and Robey, 1999), individuals' concerns, political aspects, ethics, etc. The goal of reforming IS education is to help IS professionals effectively learn from failure. With the help of systems thinking, problems with many complex systems can be studied, modeled, and simulated. It is able to make experience-based knowledge management the art of capitalizing on failures and missed opportunities (Jarke, 2002). This paper uses the MIS curricula at the Ho Chi Minh City University of Economics to demonstrate how this systems thinking can be incorporated into IS programs.

## REFERENCES

Ackoff RL. 1999a. *Ackoffs Best: His Classic Writings on Management*. Wiley: New York.

Ackoff RL. 1999b. Disciplines, the two Cultures, and scianities. *Systems Research and Behavioral Science* **16**(b): 533–537.
Anthony RN. 1965. *Planning and Control Systems: A Framework for Analysis*. Harvard University: Baston, MA.
Aram EN, Noble D. 1999. Educating prospective managers in the complexity of organizational life. *Management Learning* **30**(3): 321–342.
Avison DE, Wood-Harper AT, Vidgen R, Wood JRG. 1998. A further investigation into information systems development: the evolution of Multiview2. *Information Technology and People* **11**(2): 124–139.
Avison DE, Lau F, Myers MD, Nielsen P. 1999. Action research. *Communications of the ACM* **42**(1): 94–97.
Barker TF, Frolick MN. 2003. ERP Implementation failure: a case study. *Information Systems Management* **20**: 43–49.
Beresford JCB, Hansen P, Willis HJ. 1976. Urban information systems in cross-national perspective: a summary of observed failures to meet planners' needs. *Review of Public Data Use* **4**: 9.
Birks DF, Nasirim S, Zailani SHM. 2003. Factors influencing GIS project implementation failure in the UK retailing industry. *International Journal of Information Management* **23**: 73.
Bostrom RP, Heinen JS. 1977. MIS problems and failures: a socio-technical perspective. Part I: The causes. *MIS Quarterly* **1**(3): 17–32.
Brewer GD. 1999. The challenges of interdisciplinarity. *Policy Sciences* **32**: 327–337.
Burn JM, Ma LCK. 1997. Innovation in education: practicing what we teach. *Information Resources Management Journal* **10**(1): 16–25.
Bussen WM, Michael D. 1997. Executive information system failure: a New Zealand case study. *Journal of Information Technology* **12**: 145–153.
Chadwick DW, Mundy D, New J. 2003. Experiences of using a PKI to access a hospital information system by high street opticians. *Computer Communications* **26**(16): 1893–1903.
Chae B, Paradice D, Courtney J, Carol J. 2005. Incorporating an ethical perspective into decision support systems design. *Decision Support Systems* **40**(2):197–212.
Chan SL, Choi CF. 1997. A conceptual and analytical framework for business process reengineering, *International Journal of Production Economics* **50**(2–3): 211–223.
Checkland P. 1981. *Systems Thinking, Systems Practice*. Wiley: New York.
Churchman CW. 1971. *The Design of Inquiring Systems: Basic Concepts of Systems and Organization*. Basic Books: New York.
Clemons EK, Row MC. 1995. Identifying sources of reengineering failures: a study of the behavioral factors contributing. *Journal of Management Information Systems* **12**: 9.
Courtney JF. 2001. Decision making and knowledge management in inquiring organizations: a new decision-making paradigm for DSS. *Decision Support Systems* **31**(1): 17–38.
Croasdell D, Freeman L, Urbaczewski A. 2003. Concept maps for teaching and assessment. *Communications of AIS* **12**: 396–405.
Dahlbom B, Mathiassen L. 1997. The future of our profession. *Communications of the ACM* **40**(6): 80–89.
Dhillon G, Ward J. 2002. Chaos theory as a framework for studying information systems. *Information Resource Management Journal* **15**(2): 5–13.
Forrester JW. 1961. *Industrial Dynamics*. MIT Press: Cambridge, MA.
Forrester JW. 1969. *Urban Dynamics*. MIT Press: Cambridge, MA.
Gharajedaghi J. 1999. *Systems Thinking: Managing Chaos and Complexity*. Butterworth Heinemann: Boston, MA.
Ginzberg MJ. 1981. Early diagnosis of MIS implementation failure: promising results and unanswered questions. *Management Science* **27**: 459.
Gorgone JT, Davis GB, Vlacich JS, Topi H. 2002. IS 2002 model curriculum and guidelines for undergraduate degree programs in information systems. *Communications of the Association for Information Systems* **11**(1): 1–63.
Graham A, Morecroft J, Senge P, Sterman J. 1992. Model supported case studies for management education. *European Journal of Operational Research* **59**(1): 151–166.
Gupta JND, Wachter RM. 1998. A capstone course in the information systems curriculum. *International Journal of Information Management* **18**(6): 427–441.
Heeks R. 2002. Information systems and developing countries: failure, success, and local improvisations. *Information Society* **18**: 101–112.
Hevner AR, March ST, Park J, Ram S. 2004. Design science in information systems research. *MIS Quarterly* **28**(1): 75–105.
Hirschheim RA, Klein H. 2003. Crisis in the IS field? A critical reflection on the state of the discipline. *Journal of Association for Information Systems* **4**(5): 237–293.
Houseman CA. 1979. Disciplinarity or interdisciplinarity? In *Interdisciplinarity and Higher Education*, Kockelmans JJ (ed.). Pennsylvania State University Press: University Park, PA; 2–10.
Jackson MC. 2003. *Systems Thinking: Creative Holism for Managers*. Wiley: Chichester.
Jarke M. 2002. Experience-based knowledge management: a cooperative information systems perspective. *Control Engineering Practice* **10**(5): 561–569.
Jenlink PM. 2001. Designing educational systems for the twenty-first century. *Systems Research and Behavioral Science* **18**(4): 283–285.
Kay JJ, Boyle M, Regier HA, George F. 1999. An ecosystem approach for sustainability: addressing the challenge of complexity. *Futures* **31**(7): 721–742.

Kaye GR. 1990. Information systems successes and failures: research findings from the compounding industry. *Journal of Information Technology* **5**: 73.

Keil M, Robey D. 2001. Blowing the whistle on troubled software projects. *Communications of the ACM* **44**(4): 87–93.

Kock N, Davison R, Figueiredo A, Cunha PR. 2002. Can action research be successfully used in information systems doctoral research? In *Proceedings of the 2002 Informing Science Conference*, Cohen E, Boyd B (Eds), Computer Science Department, University College Cork: Cork, Ireland, 821–824. [Cork, Ireland, June 19–21, 2002]

Land FF, Hirschheim RA. 1983. Participative systems design: rationale, tools and techniques. *Journal of Applied Systems Analysis* **10**: 91–107.

Lee CC, Kettinger WJ, Kuilboer J-P. 1996. Market segmentation of information systems academic programs. *Journal of Information Systems Education* **8**(2): 57–65.

Lee DM, Trauth EM, Farewell D. 1995. Critical skills and knowledge requirements of IS professional: a joint academic industry investigation. *MIS Quarterly* **19**: 313–340.

Lee S, Koh S, Yen D, Tang H. 2002. Perception gaps between IS academics and IS practitioners: an exploratory study. *Information and Management* **40**: 51–61.

Lorenzi NM, Riley RT. 2003. Organizational issues and change. *International Journal of Medical Informatics* **69**(2–3): 197–203.

Lyneis JM, Cooper KG, Els SA. 2001. Strategic management of complex projects: a case study using system dynamics. *System Dynamics Review* **17**(3): 237–260.

Lyytinen K, Robey D. 1999. Learning failure in information systems development. *Information Systems Journal* **9**: 85.

Markus ML, Benjamin RI. 1997. The magic bullet theory in IT-enabled Transformation. *Sloan Management Review* Winter: 55–68.

McCray GE, Clark TD. 1999. Using system dynamics to anticipate the organizational impacts of outsourcing. *System Dynamics Review* **15**(4): 345–373.

Michaelsen LK. 1999. Integrating the core business curriculum: an experience-based solution. *Selections* **15**(2): 9–17.

Mitev NN. 1994. The business failure of knowledge-based systems: linking knowledge-based systems and information systems methodologies for strategic planning. *Journal of Information Technology* **9**: 173.

Mitroff II, Linstone HA. 1993. *The Unbounded Mind: Breaking the Chains of Traditional Business Thinking*. Oxford University Press: New York.

Murray JP. 2001. Recognizing the responsibility of a failed information technology project as a shared failure. *Information Systems Management* **18**: 25.

Mutch A. 1996. Information management: a challenge for business education, *International Journal of Information Management* **16**(6): 445–455.

Peterson DK, Kim C, Kim JH, Tamura T. 2002. The perceptions of information systems designers from the United States, Japan, and Korea on success and failure factors. *International Journal of Information Management* **22**(6): 421–439.

Pfahl D, Laitenberger O, Ruhe G, Dorsch J. 2004. Evaluating the learning effectiveness of using simulations in software project management education: results from a twice replicated experiment. *Information and Software Technology* **46**(2): 127–147.

Poon P, Wagner C. 2001. Critical success factors revisited: success and failure cases of information systems for senior executives, *Decision Support Systems* **30**(4): 393–418.

Richardson GP. 1991. *Feedback Thought in Social Science and Systems Theory*. University of Pennsylvania Press: Philadelphia; PA.

Romm CT, Pliskin N. 2000. How can we use case studies to promote soft skills in IS education? *Journal of Informatics Education and Research* **2**(3): 1–10.

Ryan HW. 1999. Managing development in the era of large complex systems. *Information Systems Management* **16**(1): 1–18.

Schmitt JW, Kozar KA. 1978. Management's role in information system development failures: a case study. *MIS Quarterly* **2**: 7.

Senge PM. 1990. *The Fifth Discipline: The Art and Practice of the Learning Organization*. Doubleday: New York.

Senn JA. 1978. A management view of systems analysts: failure and shortcomings. *MIS Quarterly* **2**: 25.

Smeds R. 1988. The role of computerized information systems in the development of organizational structure. *International Studies of Management and Organization* **17**(4): 90–104.

Takala M, Hawk D, Rammos Y. 2001. On the opening of society: towards a more open and flexible educational system. *Systems Research and Behavioral Science* **18**(4): 291–305.

Todd P, McKeen J, Gallupe R. 1995. The evolution of IS job skills: a content analysis of IS job advertisements from 1970 to 1990. *MIS Quarterly* **19**(1): 1–27.

Turner AJ. 1991. Computing curricula 1991. *Communications of the ACM* **34**(6): 69–84.

Vargo JV. 1993. Interdisciplinary coursework: a systems view. *Journal of Information Systems Education* **5**(4): 41–47.

Walsham G, Symons V, Waema T. 1988. Information systems as social systems: implications for developing countries. *Information Technology for Development* **3**(3): 189–205.

Williams GA, Heinrichs LR. 1993. A proposed MIS curriculum modeled on Anthony's pyramid. *Journal of Information Systems Education* **5**(3): 17–22.

Zack M. 1998. An MIS course integrating information technology and organizational issues. *Data Base for Advances in Information Systems* **29**(2): 73–87.