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ABSTRACT

This paper contends that establishing a central theme in the information systems curriculum is important to program stakeholders. An analysis of the IS 2010 Curriculum Guidelines (Topi et al., 2010) reveals that the systems approach can be an effective integrating theme throughout the IS curriculum. This paper concludes that the systems approach to problem solving, applied at different levels of abstraction throughout an IS program, can be a unifying theme linking technology, management, organization and transformation processes.

The systems approach is a problem solving approach to supporting organizations. The key stakeholders of information systems programs would benefit from a persistent theme of the systems approach throughout the curriculum. This paper will establish the importance of establishing a theme in the IS curriculum, define the systems approach, and examine the IS 2010 Curriculum Guidelines for elements of the systems approach. The paper concludes with tactics/strategies to integrate the systems approach to current and future IS students.

KEYWORDS

Systems approach, curriculum, information technology, information systems, information (IT) artifact, information systems (IS) discipline

The Importance OF ESTABLISHing The Curriculum Theme

Why is the theme of the information systems curriculum important? Because each key stakeholder of information systems programs must understand what skills and knowledge the program provides and must also endorse the curriculum components as pertinent and useful. Research topics of the faculty who teach in the program can shed light on their perception of the discipline's key concepts. When there is a disconnect between the research theme and curriculum theme of a discipline it may lead to confusion among stakeholders as to what constitutes the discipline.

It is not a question of deciding whether as scholars we should teach what we research or research what we teach. Good research will provide new knowledge, useful insights into interpreting what is already known, observing and collecting data pertinent to the discipline, or some other aspect that is respected by those scholars in the discipline. Academicians in the discipline of information systems have voiced that administrators, practitioners, and even other academicians do not understand *what* "information systems" really means. Because of this, it is important to remember that what is taught in the information systems discipline is how administrators, practitioners, and other academicians define the discipline. It is also important to remember that there is not a linear progression that research leads to what is taught or vice versa. Instead it it a circle between the two that constantly cycles and by having a clear concepts of that is taught in the discipline will help focus what is researched.

Literature has been written promoting the research related to the information technology (IT) artifact as *the* research that should define the information systems discipline. Benbasat and Zmud (2003) postulate that the information systems (IS) discipline does not have a cohesive, commonly agreed upon core research focus. They believe the IT artifact should be that core so that the field achieves cognitive legitimacy – i.e. acceptance as a valid discipline among the major stakeholders. Their contention is that the IT artifact as well as its construction, implementation, and organizational impact taken together achieve a recognized cognitive legitimacy among other academic disciplines, employers, students, and the university administration.

Agarwal and Lucas (2005) mostly agree with Benbasat and Zmud but differ in that they feel research should focus on the value of IT to the business, industry, and economy. The argument by Orlikowski and Iacono (2001) that the IT artifact defines the information system is accepted as de facto gospel. But a question that is not considered by these parties is whether an artifact or a theory should be at the core of the discipline. After all, it is the information *systems* curriculum and we have systems theory.

Alter (2003a, 2003b) makes the case for putting the "systems" back in the information systems core subject matter. A lively and illuminating debate played out among a number of articles in *Communications of the AIS* looking at the artifact versus the theory – in our case, technology versus systems (see Appendix 1). We as information systems academics would be wise to remember a seminal piece of advice provided by Russell Ackoff (1967) concerning the attention that computers (the artifact) were getting versus the theory (operations research/management science).

> "... for some the design of such systems has almost become synonymous with operations research or management science. Enthusiasm for such systems is understandable: it involves the researcher in a romantic relationship with the most glamorous instrument of our time, the computer. Such enthusiasm is understandable but, nevertheless, some of the excesses to which it has led are not excusable." (Ackoff, 1967, page B147)

WHAT IS PROBLEM SOLVING WITH THE SYSTEMS APPROACH

In the systems approach, IT doesn't matter. At least it does not matter as much as some have asserted. Information technology's strategic importance is minimal compared to the importance of understanding how the information *system* supports the organization, improves decision making, and adds value to an organization. Carr's assertion that the commoditization of information technology makes IT inconsequential to an organization's strategy (Carr, 2003; Smith et al., 2003) has validity. Yet Carr also notes "Companies can also steal a march on their competitors by having superior insight into the use of a new technology."(Carr, 2003, page 7) This is where a systems approach takes advantage of IT.

An abbreviated model of problem solving with the systems approach is presented in Figure 1 is presented for explanatory purposes. It is a broad brushstroke but for the presentation of the concept at this point we feel it will be sufficient for the purposes of this paper. A fuller, more robust model can be presented later.

A systems approach model is presented later in the article. Problem solving and the systems approach go hand-in-hand but they represent two dimensions of conceptualizing the system to be considered as well as how it (1) impacts and (2) is impacted by the environment and other systems in the organization.

1. Understand and frame problems
    a. understand the boundaries of the system under consideration
    b. understand key elements in the environment and their interactions with the system under consideration
    c. collect and organize important facts
2. Create higher-level solutions
    a. separate problems from symptoms
    b. explicitly recognize the possible impact of environmental factors on possible solutions
    c. be cognizant of what information may not be known or knowable that can impact solutions
3. Evaluate alternative solutions
    a. circumstances change, sometimes quickly, enough alternatives must be developed to accommodate this uncertainty
    b. explicitly recognize where different alternatives might be evaluated as "better" based upon the variety of objectives/standards that are likely to be used
4. Apply methodologies to construct and implement the chosen solution
    a. choose a method or methods best suited to the organization's needs
        i. consider skills of all concerned parties including IS professionals, users, managers, and those who will approve or disapprove the system
        ii. consider time to completion
        iii. consider likelihood of successful implementation
        iv. consider impact with entities in the environment
    b. explicitly recognize that implementation is achieved not when the IS professional ceases work but when the organization adopts and accepts the solution

Figure 1. An Abbreviated Model of Problem Solving with the Systems Approach

ALLIGNING PROBLEM SOLVING WITH THE SYSTEMS APPROACH AND THE 2010 CURRICULUM MODEL

The systems approach described in Figure 1 aligns well with key components of the IS 2010 Curriculum Guidelines (Topi, et al. 2010). Table 1 highlights a number of these components. The element from the abbreviated model of the systems approach follows each quoted description from the 2010 curriculum guidelines.

The IS 2010 Model Curriculum was developed in response to "change in technology and industry practices, including the globalization of IS development processes, introduction of web technologies, emergence of a new architectural paradigm, widespread utilization of large-scale ERP systems, ubiquitous availability of mobile computing, and broad use of IT control and infrastructure frameworks" (Topi et al., 2010, page vii). As a result, this curriculum revision represents a re-evaluation the core principles of the information systems discipline through a careful specification of the learning outcomes. Two prominent sections of the IS 2010 Model Curriculum include Section 5 – Guiding Assumptions about the Information Systems Profession and Section 9 – Outcome Expectations for Information Systems Graduates. These two sections conceptualize the overall characteristics of the IS curriculum and the learning outcomes expected. As such, these two sections are analyzed and related to the systems approach.

Section from IS 2010 Curriculum Guidelines	**Description from the Curriculum**
5 – Guiding Assumptions about IS Profession [pg. 7-8]	"Students must therefore be problem solvers and critical thinkers" [4. Apply methodologies to construct and implement the chosen solution] "Students must therefore use systems concepts for understanding and framing problems" [1. Understand and frame problems] "Students must understand that a system consists of people, procedures, hardware, software and data within a global environment" [4. Apply methodologies to construct and implement the chosen solution]
9 – Outcome Expectations for IS Graduates [Exploiting Opportunities Created by Technology Innovations, pg. 17]	"Graduates of Information Systems Programs should be experts in …. converting opportunities created by information technology innovations into sustainable organization value through systematic processes" [1. Understand and frame problems] "Achieving a high level of performance related to this capability requires …… skills in analyzing problems and design solution alternatives, ability to analyze the strengths and weaknesses of various alternatives ……." [3. Evaluate alternative solutions]
9 – Outcome Expectations for IS Graduates [Identifying and Evaluating Solution and Sourcing Alternatives, pg. 18]	"Graduates of IS programs are capable of producing high-level design alternatives for various IT-based solutions" [2. Create higher-level solutions]
9 – Outcome Expectations for IS Graduates [Information Systems Specific Knowledge and Skills, pg. 19-23]	"Analyzing trade-offs. One of the most important knowledge and skill categories for Information Systems graduates is the ability to design and compare solution and sourcing alternatives …." [2. Create higher-level solutions] "Comparing solution options using multiple criteria" [2. Create higher-level solutions] "Identifying, evaluating, and procuring detailed solution and sourcing options" [2. Create higher-level solutions] "… essential that they are able to systematically analyze complex systems and situations, break them down into manageable components, understand deep connections within systems, and create solutions based on the results of a systematic analysis. Problem solving is also omnipresent in the life of IS professionals." [4. Apply methodologies to construct and implement the chosen solution]

Table 1. IS 2010 Curriculum Guidelines and the Systems Approach

The IS 2010 Model Curriculum is quite clear in its belief in the importance of having students apply a problem solving methodology. It is also clear that this problem solving methodology should not just be applied to narrowly defined technical problems such as database design and computer programming, but should be expanded to include problems at a broader business level. Gefen et al. [2012] confirm this conclusion in an ICIS 2011 Panel Report:

> "CIOs need us to teach students to see the business problem and have a creative, imaginative information systems solution for it. Learning how to design a database or write an application for it in C++ are clearly necessary, but on top of that the students we train must know and understand the business problem that the database and C++ application are solving. CIOs do not need us to train CS students; we need to train Business majors who know the technology, and, importantly, understand where it fits in and how it serves the organization and its users." [Gefen et al., 2012, page 164]

THE SYSTEMS MODEL

The construct of a general system model is well known (Kast and Rosenzweig, 1972). Inputs flow to a transformation process that flows to the output. Inputs could be wood flowing into a carpentry process and flowing out as chairs. A database table might be an input flowing to a report generator yielding a sales report. Adding a feedback loop to the process and/or the inputs segment of the model creates a controllable system.

We contend that a systems approach to the information systems curriculum will achieve foundational skills of IS program graduates. The problem solving, systems approach has been has been used in introductory MIS textbooks as the theme around which information majors were taught (McLeod and Schell, 2001) in the past. The systems content in introductory MIS textbooks has lessened as the power, economy, friendliness, and omnipresence of technology has caught more attention. Yet the problem solving, systems approach to the IS curriculum directly addresses analytical and critical thinking objectives in the IS 2010 Curriculum Guidelines.

> "Strong analytical and critical thinking skills are a foundation for everything IS professionals do – it is essential that they are able to systematically analyze complex systems and situations, break them down into manageable components, understand deep connections within systems, and create solutions based on the results of a systematic analysis. Problem solving is also omnipresent in the life of IS professionals." (Topi, et al. 2010, page 21)

For our purposes we will use a simplistic representation of a system shown in Figure 2. The environment encloses the system and within the system we represent five major subsystems in the organization: (1) management & organization, (2) inputs, (3) transformation process, (4) information technology, and (5) outputs. Each subsystem may contain as many *sub*systems as necessary to adequately represent the system. However, none of the five initial subsystems should be eliminated unless there is a compelling reason and it is adequately articulated before the subsystem is removed.

Two features of the simplistic system bear further explanation. Management and organization (the structure of the management) is necessary in the systems approach since this subsystem is generally first to recognize a need for a system to be created, deleted, or modified and also because this subsystem will provide measures for determining system success. Also notice that the transformation process subsystem is distinct from the information technology subsystem. We are separating the system from the artifact.

All of these are subsystems. It is important in the systems approach to information systems that there is an explicit recognition of the organization as the system and explicitly dealing with information systems as *sub* subsystems contained within the organization's boundaries. The system depicted in Figure 2 allows users to explicitly and systematically analyze each part and apply critical analysis to each part as well as the combination of parts.

No relationships between the major subsystems have been drawn. Their relationship(s) to each other should be established by the circumstances of the process being modeled. The user is free to add subsystems as needed. An important feature when adding subsystems and/or sub-subsystems is that the user is forced to explicitly consider the boundaries and inputs/outputs of each added subsystem or sub-subsystem.

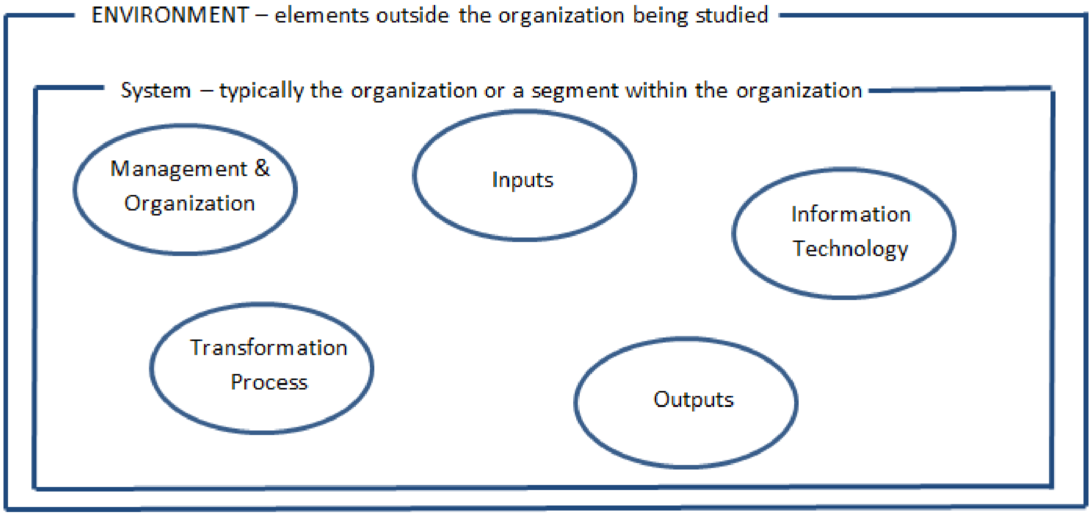

Figure 2. Simplistic Representation of a System within an Organization

CONCLUSION

The systems approach can be used as an integrating theme throughout the IS program. In particular problem solving using the systems approach can be presented at different levels of abstractions throughout the curriculum. For example, the same problem solving methodology used to solve a low-level, technical database design problem in a database course can be applied to a high-level, business sourcing decision in an IS strategy course. Students should learn that problem solving is an inherent part of the IS profession and can be applied to different types of problems at different levels of abstraction in different industries and organizations.

In an age where creativity and innovation are increasingly important in the IS curriculum [Fichman et al, 2014], the systems approach offers an effective mechanism to introduce techniques for idea generation and innovative thinking. In particular, the systems approach calls for creativity and innovation when developing alternative solutions to a problem. Although technology is a powerful and important resource for complex solving problems, it is a problem solving methodology following the systems approach that adequately accounts for various sources of risks and dimensions of feasibility - including technology characteristics, availability of and organizational ability to use human resources, scheduling, organizational politics, regulatory issues, and return on investment.

APPENDIX 1.

All citations below are from the *Communications of the Association for Information Systems* and refer to a series in the journal titled *The IS Core*. The articles are listed in chronological order instead of alphabetical order by author.

Title	*Author(s)*	*Year, volume, article*
The IS Core – I: Economic and Systems Engineering Approaches to IS Identity	Dufner, D.	2003, 12, 31
The IS Core – II: The Maturing IS Discipline: Institutionalizing our Domain of Inquiry	Power, D. J.	2003, 13, 32
The IS Core – III: The Core Domain Debate and the International Business Discipline: A Comparison	Deans, P. C.	2003, 12, 33
The IS Core – IV: IS Research: A Third Way	McCubbrey, D. J.	2003, 12, 34
The IS Core – V: Defining the IS Core	Guthrie, R. A.	2003, 12, 35
The IS Core – VI: Further Along the Road to the IT Artifact	Saunders, C. and Wu, Y. A.	2003, 12, 36
The IS Core – VII: Towards Information Systems as a Science of	Iivari, J.	2003, 12, 37

Meta-Artifacts		
The IS Core – VIII: Defining the Core Properties of the IS Discipline: Not Yet, Not Now	Meyers, M. D.	2003, 12, 38
The IS Core – IX: The 3 Faces of IS Identity: Connection, Immersion, and Infusion	El Sawy, O. A.	2003, 12, 39
The IS Core – X: Information Research and Practice: IT Artifact or Multidisciplinary Subject?	Holland, C. P.	2003, 12, 40
The IS Core – XI: Sorting Out the Issues About the Core, Scope, and Identity of the IS Field	Alter, S.	2003, 12, 41
The IS Core – XII: Authority, Dogma, and Positive Science in Information Systems Research	Westland, J. C.	2004, 13, 12

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