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Systems Theory: Should Information Researchers Even Care?

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ABSTRACT

Several prominent perspectives that offer valuable insight and quality contributions to academic research currently influence the field of information systems (IS). The purpose of this paper is to discuss *systems theory* within the field of IS and provide evidence of its merit for adding useful perspective in conducting IS research. This is accomplished by the following: First, the historical background and context for systems theory is provided and put in relation to information systems; second, we review a case study that uses a systems theory perspective to demonstrate its real-world application; and third, we discuss the ways in which systems theory can make new contributions to the field of IS and which warrant its further consideration as a lens for conducting research. The purpose of this paper is to move the discussion forward regarding systems theory application in the IS field and to demonstrate that it has and continues to have significant research implications.

Keywords

Systems theory, general systems theory, work systems, soft systems methodology

INTRODUCTION

Information systems (IS) is a highly diverse area of study, with theory, both new and old, making contributions to research streams and advancing the field. However, one particular theory has seemingly been left by the wayside with respect to research in IS. Systems theory is not a 'mainstream' topic of study or application within IS, even though valuable contributions have occurred that can be traced as far back as the *general systems theory* origin. Concepts or areas such as *soft systems methodology* (Checkland 2000) and *work systems theory* (Alter 2002) have contributed to important research streams with ongoing opportunity for further research and subsequent publications. If this is the result of evolving systems theory within IS, then why it has been largely ignored in applications and not been explored in greater depth? For a field of study that, at least in name, is concerned with systems, it is a question worth exploring. It is for this purpose that this paper has been written: to explore systems theory and its contributions and applications, and to determine if IS research should indeed provide this topic with greater attention that may result in quality research contributions. This is not a call to action for systems theory or thinking to be adopted (Alter 2004); however the objective is to explore whether IS *should* consider systems theory when conducting research, based on the potential value of its contributions. The format of the paper is as follows: First, a brief historical background and context for systems theory is provided and related to IS; second, we review a case study that uses a systems theory perspective to demonstrate its real-world application; and lastly we discuss ways in which systems theory can make new contributions to the field of IS and which may warrant its further consideration as a lens for conducting research.

SYSTEMS THEORY

Origin

The origins of systems theory, more formally known as general systems theory, are traced back to the work of Ludwig von Bertalanffy's seminal 1950 paper *An Outline of General System Theory*, where the foundations for GST were laid. The objective of his work was to resolve the practice of researching phenomena by breaking them down into independent parts that can be studied in isolation, but without respect to the problem as a whole (von Bertalanffy 1950). Von Bertalanffy discovered that not only did research of isolated elementary parts occur in all branches of science, but he found "similar fundamental conceptions appear in all branches of science, irrespective of whether inanimate things, living organisms, or social phenomena are the objects of study" (von Bertalanffy 1950). This is to say that, underlying these differing approaches to research and through disparate fields of study, similar general concepts of understanding were achieved that permeated throughout all of them. Von Bertalanffy found this propensity for similarity even more astounding in that these general understandings were almost exclusively developed mutually independently with researchers unaware of each other. Even more striking was that these common approaches were often based on different facts and philosophies that seemingly were in opposition to each other (von Bertalanffy 1950). For von Bertalanffy, this meant that "There exist therefore general system laws which apply to any system

of a certain type, irrespective of the particular properties of the system or the elements involved," which is to say that these general system laws could be formulated into a new basic scientific discipline (von Bertalanffy 1950).

This new scientific field, so called general systems theory, was formed as a logico-mathematical discipline that was intended to be purely formal and applicable to all sciences concerned with systems (von Bertalanffy 1950). The greatest concern of this new discipline is that of the principles or 'rules' which apply to systems in general as well as the nature of the components and the relationships between them (von Bertalanffy 1950). This concentration on 'systems' as the foundation for general systems theory however was lacking with regard to how one might approach research through this new scientific field. While justification for the need for a 'systems approach' and its scientific nature is provided by von Bertalanffy, the approach for conducting research in this manner is supplied through Kenneth Boulding's 1956 work *General Systems Theory—The Skeleton of Science,* whereby two different approaches are identified for conducting systems research (Boulding 1956).

Boulding's work posited that two approaches exist with respect to conducting research under a general systems theory perspective. The first being that a researcher would find an empirical field of study, select a topic or phenomenon to study, and then build general theoretical models which are relevant to the given topic or phenomenon, while the second approach is to take an empirical field and arrange it in a hierarchy of complexity with respect to organization of the parts and their respective behaviors, and then develop a level of abstraction that is appropriate (Boulding 1956). This idea of systematic frameworks allows researchers to capture systems of many different types and provides a general guideline for the basic theory it attempts to explain.

It is from this foundation then that Klir's work, *Facets of Systems Science*, seeks to advance theory and a relational model upon which work can be framed in the vein of legitimate and valid science (Klir 2013). The model upon which this expansion of theory is based is expressed as S = (T, R) where S is a 'system,' T is a set of certain things and R is a relation defined on T (Klir 2013). From here, Klir explains the vast possibilities in which both T and R can exist and be expressed, as T can represent an unlimited number of 'things' and thus R can then represent every relationship in which T can be involved (Klir 2013). Additionally, Klir discusses the idea of 'holism' within systems science whereby a researcher seeks to express in a holistic manner the representation of an entire system, which includes all things and relationships that can be inferred through observation that may exist within it. These holistic organizations exist in a hierarchy, where the relations are expressed between objects within the system and can exist in any number of ways. Klir also discusses the concept of dual roles and autonomous and controlled systems as a means of expressing additional relationships in the context of systems science (Klir 2013).

The work of von Bertalanffy, Boulding and Klir can serve as the foundation for the systems theory perspective and its place in the field of IS. The field, so named information systems, should then be concerned with the study of systems and as such accepting of the concept of systems theory in its research. By using the approaches outlined by Boulding and framing an understanding provided by Klir, IS can conduct research that is not only of publishable merit, but maintains the benefit of existing at a higher level of abstraction than basic methodology. So the question then becomes whether any significant work currently exists utilizing these principles to advance the use of systems theory in the field of IS, using these foundational concepts. For this we explore the literature to determine if any such contributions exist.

Relation to Information Systems

When looking for work in the field of IS that utilizes systems theory, two distinctive areas stand out: *soft systems methodology* and *work systems theory*. These two streams of research have not only been informed by the overall conception of systems theory but have also made significant contributions of their own through the adoption of this theoretical perspective. For this reason it is important to provide some discussion regarding these topics of research as they have had and continue to have significant impact in the field of IS.

Soft Systems Methodology

Developed by Peter Checkland (2000), soft systems methodology was developed as an approach for solving problems by viewing them as systems that can be modeled and solved. In this regard, Checkland developed a seven-stage model by which problems are identified and modeled. Soft systems methodology models *human activity systems,* which can be immensely varied and complex, thus an approach for structuring and defining this activity is very important (Checkland 2000). Soft systems methodology achieves this goal through four main activities: (1) Researching and understanding a problem situation, including from a cultural and political perspective; (2) formulating relevant and purposeful activity models; (3) deliberating the situation using the models in order to identify feasible and desirable changes to improve the situation; and (4) taking action in the situation to bring about improvement (Checkland 2000). This methodology has continued to evolve over the years, being enhanced and revised to achieve its ultimate goal and informing new research in the field of IS.

Work Systems Theory

From soft systems methodology, work systems theory emerged as a means of understanding, analyzing, and improving systems in organizations, whether or not IT is involved, using the concept of a *work system* as its focal point (Alter 2002). Work systems theory is founded upon general systems theory and includes two separate views: static and dynamic (Alter 2002). A static view is that of a current (or proposed) system in operation, while a dynamic view is that of how a system evolves over time, either through planned changes or unplanned adaptations (Alter 2002).

The static view is based on the *work system framework*, whose purpose is to identify the basic elements for understanding and evaluating a work system (Alter 2002). The work system framework is sufficiently prescriptive to accomplish the following: describing the system being studied; identifying problems and opportunities; describing possible changes; and tracing the likely impacts of those changes as they propagate to other parts of the system (Alter 2002). Unlike the static view, the dynamic view is instead based on the *work system life cycle model*, which explains how a work system evolves through multiple iterations of four distinct phases (Alter 2002). Together, these two views are used in a systems analysis method that is principle-based and which treats the information system as part of the work system until the final step in the process, at which point it then distinguishes the work system changes that do or do not involve the information system itself (Alter 2002). This work system theory constitutes a continuing research stream that has resulted in significant contributions to IS research.

CASE STUDY USING SYSTEMS THEORY

Background

Demetis (2010) conceptualized a case study of Drosia bank and its proposed anti-money laundering system through the use of systems theory. The bank needed to create a comprehensive solution to the problem of money laundering for a diverse number of reasons, which caused them to view the problem as a whole, moving beyond simply compliance, and looking at the process of how anti-money laundering works (Demetis 2010). Demetis, in his review of the case study on Drosia Bank, recognizes that the bank and its staff are genuinely interested in solving the anti-money laundering issue as well as the varied concerns and challenges it presents. Demetis then works to resolve the anti-money laundering issue, which is practical in nature, with the theoretical concepts of systems theory, in order to bridge the gap between these two concepts. This re-conceptualization is done as follows: First, using systems theory, anti-money laundering viewed as a system is discussed; second, a conceptual schema is created that frames anti-money laundering as a functional system of society, and discusses how this reframing changes the dialogue around the anti-money laundering issue (Demetis 2010). Demetis then uses the empirical evidence gathered in the case study as well as the discussion around systems theory and the reframing of the anti-money laundering issue to tie back to the field of IS as a whole. It is the use of systems theory, empirical evidence, and logical discussion that allows Demetis to reframe this work into the model of systems theory and make a contribution to the field of IS. To better explain the contribution of this work in the context of IS and systems theory, we review the process and challenges in the following section.

Systems Theory Conceptualization

In order to analyze the contribution made by this case study, it is important to first understand the original conceptualization of the organization, as it saw both itself and the anti-money laundering system (AMLS), and how a researcher using systems theory would conceptualize the organization and the AMLS. In the left side of figure 1 (not using systems theory), the organization and the AMLS are conceptualized as completely separate entities, where the organization provides inputs to the AMLS and receives outputs (i.e. the results produced by the AMLS) from the AMLS. The inherent difficulty with this conceptualization is that the current anti-money laundering work, both the roles and responsibilities for it, are done by multiple employees, using both computer and non-computer based processes, and departments within the organization. In order to organize, structure, build and implement a coherent and functional AMLS, all individual components must be understood. This is where the use of systems theory can help a researcher and an organization accomplish better understanding of a complex and varied problem.

The use of systems theory in conceptualizing an organization can be a powerful tool in mapping the roles, responsibilities and interactions of those involved in the AML process. The right side of figure 1 shows how an organization can be conceptually rendered using systems theory to illustrate how it functions and interacts. In the right side of figure 1, people and work systems are represented as elements with each having its own role and responsibilities. Between each element a relationship exists, which can be thought of as a communication, where each element can act out its role and associated responsibilities with other related elements. These relationships are important as they impact the ability of each element to act out their role and responsibilities within the organizational system. The organizational system can receive inputs, which may be from its external environment or imposed upon itself, such as the implementation of a new AMLS. From these various inputs, elements and their relationships, the organizational system produces outputs, which results from the successful enactment of the relationships between the necessary elements inside the system.

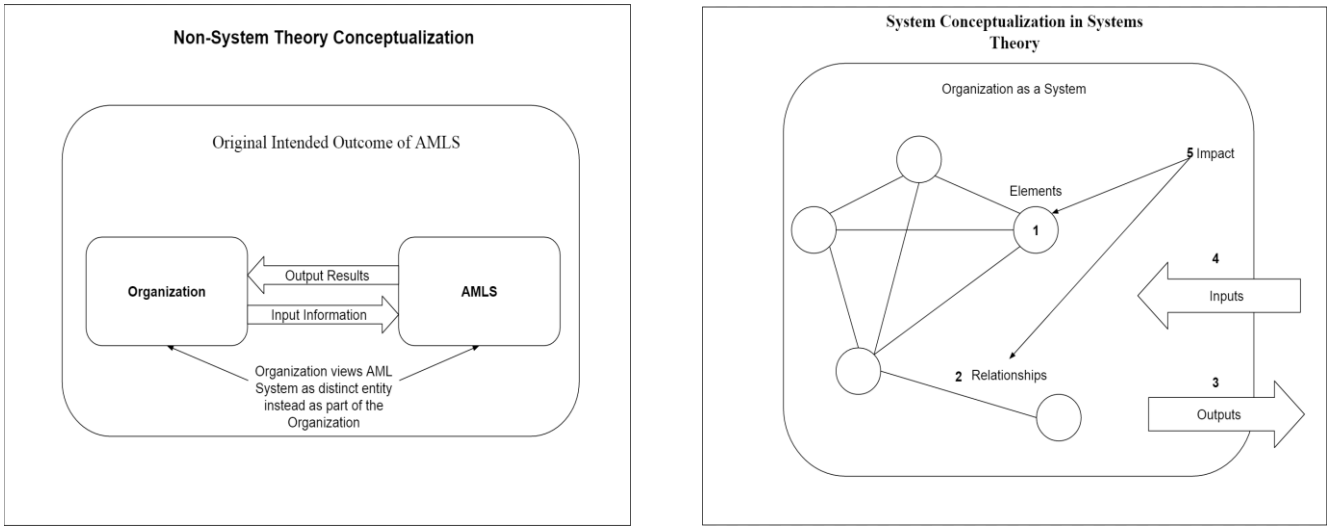

Figure 1. Non-Systems Theory and Systems Theory Conceptualizations

Now that an understanding of how systems theory can be used is established in the context of an organizational system, it can be applied to the case of an AMLS. The left side of figure 2 illustrates how the current organizational system can be conceptualized using systems theory in the context of understanding the anti-money laundering process currently in place. It shows that the organization has a complicated system for enacting its anti-money laundering processes, with varied elements completing only portions of the anti-money laundering tasks and having overlapping and disjointed relationships by which they communicate information. The input for this context is the information necessary to determine money laundering activities and the output should be a result that helps the organization determine whether an act of money laundering has occurred or not. The issue is that in the left side of figure 3, each element may have roles and responsibilities that are vital to conducting anti-money laundering activities, but do not have the relationship necessary to communicate that information properly. Additionally, vital roles may not be fully accounted for and redundancy can occur with some elements even having overlapping responsibilities. These challenges can result in poor communication and execution, which ultimately degrades the output of the system and diminishes the efficacy of the anti-money laundering efforts.

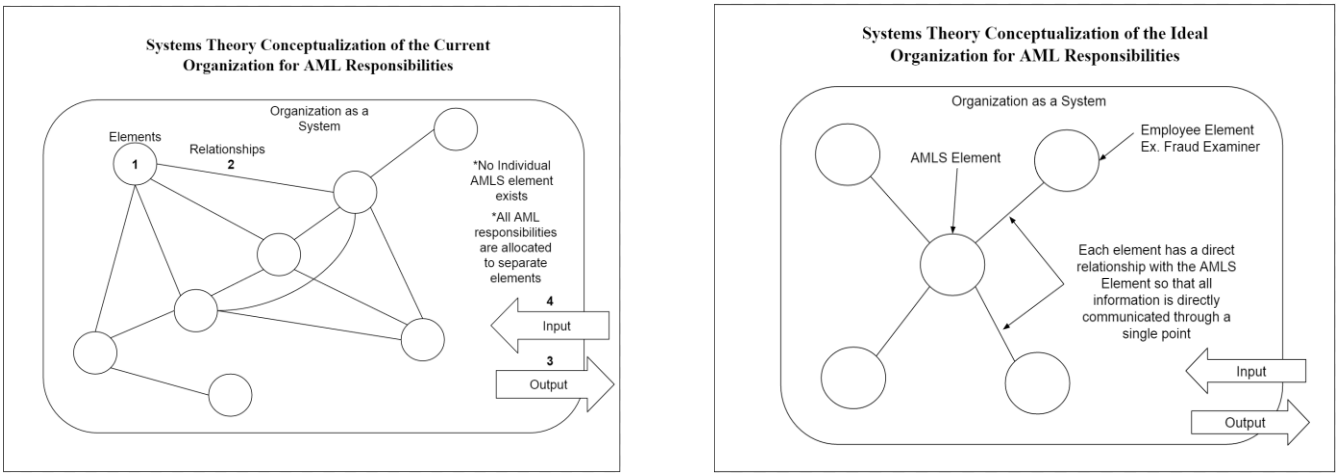

Figure 2. Conceptualization of Current and Ideal System

The goal of implementing systems theory is to not only understand the organization as it is, but also to re-envision it as it should be in an ideal situation. In the right side of figure 2, the organizational system is presented in its ideal state, where the system can produce the ideal outputs. In this situation, the AMLS is viewed as also part of the organizational system as an element and has its own unique role and responsibilities. This allows each additional element to have a direct relationship with the AMLS where information exchange is direct and can be accessed by elements even in separate departments and restricted to what information is available and to whom.

From here, the benefits of the use of systems theory can be evaluated based on the challenges presented in this particular case study. Table 1 shows the challenges that had to be overcome in order to achieve an effective and worthwhile AMLS, and how, through systems theory it was accomplished as it provided the resulting benefits.

Challenges of AMLS Implementation	Benefits of Systems Theory on AMLS Implementation
Lack of Clearly Defined Roles in new system	Clearly defines roles and responsibilities of each element
Lack of Clearly Defined Responsibilities in new system	Creates structure that demonstrates relationship pathways that channel communication of information
Current Organization of AML duties lacks coherent structure	Maps necessary relationships for communication to occur and produce desired AMLS output
Multiple sources of information require integration with new AMLS	Allows Organization to determine how AMLS will alter elements and relationships of the Organizational System

Table 1. Challenges and Benefits

DICUSSION AND CONCLUSION

The use of systems theory in the field of IS is not a new concept, however it has not generated the level of research that other theory (e.g. technology acceptance model) has. This can lead one to questions then whether or not systems theory does indeed make a valuable contribution to IS research, both current and future. A careful look at the literature does indeed show that systems theory within the field of IS has made some notable contributions and the case study shows that application of systems theory can result in better conceptualizations of real world problems, and thereby contribute to better solutions. Areas of contributions such as soft systems methodology (Checkland 2000) and work systems theory (Alter 2002) demonstrate the ability of systems theory to inform such work and create long and beneficial streams of research, while the case study on Drosia Bank (Demetis 2010) serves as an example of how it can like-wise inform actual practice and study in the field. This then should lead IS researchers to explore the possibilities of using systems theory in their own research, perhaps leading to better conceptualizations and thus understanding of some complex problem situations.

The contributions of this paper are that it moves the discussion forward regarding the use of systems theory in IS research and demonstrates that useful contributions can be made by systems theory to both further other IS theory and improve IS practice, thereby offering viable paths for new research. When a particular theory or methodology is both valid and useful, but remains relatively unexplored, it presents opportunity to move the field into new directions and make a lasting impact in the field. Systems theory, in the case study described in this paper for example, provided Drosia Bank with a method for mapping and understanding their organizational needs in order to effectively implement an AMLS. Without this type of insight the organization would have failed to address all the challenges presented, and ultimately may have been unsuccessful in its attempt at curbing money-laundering activities.

In future research, a greater, in-depth review of systems theory may be conducted to provide a framework for new case studies that look to pair systems theory with other methodologies synergistically and to explore further areas of interest. Also, a more systematic review of past and current IS systems theory research may be useful, to help future researchers to target under-researched streams for further exploration.

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