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Is Information Systems a science? An inquiry into the nature of the information systems discipline

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Abstract

The Information Systems (IS) discipline is apparently undergoing an identity crisis. Academicians question the need for IS departments in colleges stating the absence of a core for the field and its integration within other business functions as a basis for its elimination. At the same time, many practitioners, as reflected in the US government's recent IT labor shortage report, continue to ignore IS as a distinct field of study. This article briefly outlines these and other challenges and argues that notwithstanding underlying philosophical differences, it can be concluded that IS is an emerging scientific discipline. This conclusion is reached through an assessment of the debate surrounding the issue of whether IS should be a discipline and an analysis of the IS discipline using some key characteristics of "science." The arguments put forth in this paper have four key implications for the IS community: a continuing emphasis on adopting scientific principles and practices for conducting inquiry into IS phenomena; an enhancement of the self-concept of IS academics and professionals through a common identity; enhances the ability of supporters of the IS field to defend against criticisms, integration with other disciplines, and resource rivalry; and creates the potential of being well-situated to building a cumulative tradition in the field.

Categories and Subject Descriptors: H.0 General; H.m Miscellaneous

Keywords: Information systems discipline, philosophy of science, information systems discipline, scientific inquiry, characteristics of scientific fields.

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Science is:

- *"the state of knowing-knowledge as distinguished from ignorance or misunderstanding;"*
- *"knowledge or a system of knowledge covering general truths or the operation of general laws especially as obtained and tested through the scientific method."(Meriam-Webster Online 1998).*

Introduction

The information systems (IS) field is currently undergoing a "crisis of identity" with both IS and non-IS commentators from academia and practice questioning its fundamental tenets, contents, philosophical underpinnings, methodologies and practical relevance (Checkland and Holwell 1998, Mingers and Stowell 1997). IS academic departments are facing constant pressure from other academic institutions that question the need for IS departments in colleges stating the absence of a "core" for the field and its integration within other business functions as a basis for its elimination (Davis et al. 1997, Jones 1997). In a similar vein, some authors see IS merely as a subset of the various "reference disciplines" from which the field has borrowed, e.g. computer science and organizational science (Benbasat and Weber 1996). On the other hand, IS research has also been accused of being reactive and impractical, resulting in limited relevance of research outcomes and near ignorance by practitioners in the field (Benbasat and Zmud 1999, Ciborra 1998, Davenport 1997, Saunders 1998). Lastly, a growing number of IS academicians who have examined the philosophical underpinnings of the IS field, argue that scientific inquiry à la natural science and associated scientific research methods are not directly amenable for research in the IS discipline (Banville and Landry 1989, Klein and Lyytinen 1985, Mingers and Stowell 1997).

Thus, of fundamental importance to the further existence of IS as a unique academic and professional field is the question of whether IS should be regarded as a discipline and that it merits being designated as a science. In this paper we address this question by conducting a critical assessment of the nature of the IS discipline. In pursuing this goal of assessing the nature of the IS discipline in this paper, we apply criteria based on a version of the natural science model (Burrell and Morgan 1979). Although acknowledging the debate on the relevance of these criteria for assessing the IS field, we argue that notwithstanding philosophical differences, there are some fundamental characteristics of natural sciences that are clearly applicable to the IS field. The fact that the authors of this paper represent different perspectives, one is a declared scientific realist in the tradition of Hunt (1992) and the other is an interpretivist in the tradition of Walsham (1993), demonstrates how it is possible to reconcile different perspectives regarding the question of whether IS should be viewed as a scientific discipline.

The rest of the paper proceeds as follows. First, the background for this inquiry is presented through a discussion of the state of the IS discipline. The issue of whether IS should be viewed as

a 'discipline' is also briefly addressed in this section. Next, the nature of science is outlined. The fundamental characteristics of science are used to frame the ensuing discussion about the nature of the IS discipline. Thus, in analyzing the nature of IS, we attempt to explore the following questions: What kinds of phenomena are included in the study of Information Systems? (Or, what is the scope of IS?) What is the conceptual domain of the IS discipline? What is the potential of finding underlying uniformities in the IS discipline? What is the status of methodological rigor in IS research? We believe, that these questions go to the crux of understanding whether IS should be regarded as a scientific discipline.

The State of the IS discipline

Challenges to the IS field

In an editorial in *Information Systems Research*, King (1993, p. 293) rhetorically asserts "What is the information systems 'field'?" He then goes on to answer the question thus: "… information systems is probably *not even a field*, but rather an intellectual convocation that arose from the confluence of interests among individuals from many fields…" (emphasis added). Similarly, some authors have questioned whether IS can survive as a unique discipline (Markus 1996). In fact, Markus (1996) raises the specter of "what happens if the IS field as we know it goes away" and rhetorically queries "… given the ubiquity of computing, why does the world need a field that specializes in IT, independent of, or abstracted from, particular substantive applications? In a world of inevitable resource constraints, why should business school deans *not* try to achieve excellence in IT without the expense of an AIS ("academic information systems") unit by hiring IT-knowledgeable non-IS faculty?" (p. 1). She also asserts that one indicant of the discipline's "lost identity" is the fact that the IS field is being co-opted into other fields such as organizational behavior or marketing.

Jones (1997) refers to a decision of the American Association of Schools of Business to exclude IS from the core curriculum for accredited American Business Schools. The full statement reads (p. 102): "A sign of the relative weakness of the IS field, however, is that its discipline mechanisms are largely dependent on other structures for their influence. Thus the Association of IS in the USA is, in part, a defensive reaction against the decision of the American Association of Schools of Business to exclude IS from the core curriculum for accredited American Business Schools (Dickson et al. 1993)". This may potentially be a global phenomenon as exemplified by the situation in the Norwegian School of Management, where the former Department of Information Systems Research has been incorporated into the Department of Strategy and Management, now being referred to as the information management area. Similarly, Avgerou et al. (1999) assert that the potential of "marginalization of IS within academia is considered to be a threat in the UK, while in most countries there is concern that the field may be absorbed by more established disciplines" (p. 149). In addition to the above, consider the recently reported study by Watson et al. (1999). They interviewed 17 leaders in the IS field about the current state of the IS academic discipline. They found that interview subjects where concerned whether the IS field "can maintain and expand its position as an independent discipline" (p. 10). In addition, the concern was expressed that IS could be absorbed into other organizational units such as

accounting or schools of information technology[1]. The latter situation is clearly already occurring as IS department in many universities are merged into Accounting or Computer Science departments or reorganized into new Schools that integrate Computer Science, Telecommunications and Information Systems functions. Adding to this "confused state" of the IS field is the difficulty of keeping up with the dramatic technological advances that are occurring every day (Checkland and Holwell 1998). After all, "… practice will tend to outrun the development of the thinking in any field in which the technological changes come very quickly indeed, as has been the case with computing hardware and software" (ibid. p. 56). In addition, Falkenberg et al. (1998) cite the following factors as sources of the identity crisis in the IS field: the interdisciplinary nature of the area, the large variety of interest groups (for example suppliers of IT products and services versus IT users), conflicting philosophical positions (for example objectivist versus subjectivist assumptions) and the complex, multilayered communication structure related to IS that may result in different terms being interpreted differently depending on the focus of the communication.

Different aspects of the questions raised in the previous paragraphs have recurred throughout the evolution of the IS field. Orlikowski and Baroudi (1991, p. 2) accurately summarize the history of this introspective debate asserting that, "much recent self-reflection in the information systems discipline has involved a discussion of the status of information systems research vis-à-vis the norms that constitute a scientific discipline…." In a similar vein, various conference panels and workshops have been convened to debate these fundamental issues (Introna and Whitley 1997, Benbasat and Weber 1996). In fact, Introna and Whitley (1997) surmise that these are all signs of a "Kuhnian crisis" in the IS field. They base their conclusion on the fact that current papers by IS scholars have been skeptical about everything in the field from the way IS research is conducted to the effectiveness of current techniques (p. 485).

However, Banville and Landry (1989), argue that Kuhn's paradigm model represents a monistic view of scientific development that may actually be inadequate for the IS (MIS) field by contributing to a narrow and restrictive view of what is to be included in this field. Instead they adopt Whitley's (1984) model of scientific fields as a basis for classifying the nature of MIS as an intellectual field. According to this model, they argue that IS at this stage fits the characteristics of a *fragmented adhocracy*, characterized by a lack of coordination in the field, research agendas being personal and fragmented, a lack of standardization of research methods, weak entry barriers and ephemeral coalitions. Of the different states in this model, a fragmented adhocracy is actually most likely to be liable to an identity crisis. In making this argument, they also emphasize that a scientific field should be seen as a "perpetual and continuous social construction", implying that any field will evolve over time as a result of the common influence of the scientific community in this field.

The above ongoing and at times fragmented debate is clearly indicative of the interest in understanding and shaping the fundamental nature and philosophical underpinnings of the IS

[1] A potential limitation of this study is that it only included US "leaders".

field. The IFIP WG 8.2 has been very active in providing a forum for different viewpoints in this deliberation (e.g., Falkenberg et al. 1995 and 1998) about the essential nature of the IS "field." The 1984 IFIP WG 8.2 colloquium title astutely summed up this problem under the theme "IS research - a doubtful science?" This title was chosen to "call into question the notion of research in information systems being a science, in the same sense as research in the physical or natural sciences, and to ask whether the scientific research methodology is the only relevant methodology for information systems research or indeed whether it is an appropriate one at all" (Mumford et al. 1985, p. 3). Several authors, including many contributors to this IFIP colloquium, have addressed the current status of scientism in IS research, arguing that the emulation of scientific methods from the natural sciences in IS research actually represents an anomaly of this research (Boland 1986, Galliers 1985, Klein and Lyytinen 1985). On the other hand, other authors have established that scientism has been the dominant IS research perspective in the past (Orlikowski and Baroudi 1991) and will continue to play a key role in shaping IS research in the future (Cushing 1990).

The Rigor vs. Relevance Debate

Given the relatively brief epistemological history[2] of the IS field and the prevalent use of a variety of phrases[3] to label the field both in academia and practice, it is not surprising that this debate about the underlying nature and scope of IS has continued to rage. Adding further to this crisis of identity is the apparent lack of recognition by practitioners and some governmental agencies of IS educational offerings. One current example of this is the "IT labor shortage report" published by the Office of Technology Policy in the US Department of Commerce (1998). It more or less ignores the IS program offerings in US educational institutions and the exponential growth of IS programs in business schools in the past few years. Another dimension of this challenge is the role and relevance of IS research to practice. There is an ongoing and critical debate about the relevance of IS research and education as it relates to practice (Benbasat and Zmud 1999, Galliers 1997, Saunders 1998, Trauth et al. 1993). For example, Davenport (1997), a practitioner turned academic, writing for *CIO magazine* argues that one key problem with the IS discipline is the "ivory tower" mentality of its academics that results in research activities that are neither "comprehensible nor practical." This causes them to only "partially realize potentially fruitful relationships with industry." Some authors also argue that rather than providing leadership in research and development, the IS academy has been led by practice to a large extent, mostly rediscovering findings that are already implemented in practice, thus adding to the crisis mode of the field as a whole (Ciborra 1998, Davenport 1997).

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[2] Davis et al. (1997, p. 6) estimate that IS as a field of academic study is only 30 years or so old. This should be kept in context when comparing IS with the natural or social sciences and the other business areas such as Economics and Marketing that have a strong tradition that dates back many years. Both Checkland and Holwell (1998) and Markus (1996) point to the relatively short life of the IS field as a potential reason for the "confusion" about its purpose and conceptual domain.

[3] For example: Information Technology, Information Science, Management Information Systems, Information Resources Management, and Informatics (Davis et al. 1997, p. 7).

The problem of lacking practical relevance is often explained by the tendency in IS academia to emphasize *rigor* over *relevance*, implying a trade-off situation between these two goals. However, several authors have argued (and we would concur) that rigor and relevance should not be seen as conflicting targets, and that it is possible to pursue both. For example, Benbasat and Zmud (1999) apply four dimensions in their definition of relevance: *content* (*"interesting, applicable, current"*) and *style* ("*accessible*"). They argue that it is possible to obtain relevance while conducting rigorous research. However, they argue that this will require changes in the editorial review process in IS journals that establishes an increasing focus on relevance among the reviewers.

However, other authors argue that the rigor vs. relevance issue cannot be adequately addressed without first clarifying the concepts of relevance and rigor themselves (Lee 1999). Important questions to be resolved include for example who should decide what is relevant, and what philosophical paradigm is to be used in deciding which IS research is rigorous (Galliers 1997). The complexity of this issue is further increased by taking into account the role of institutional influences, geographical variations (e.g. North American vs. European practices) and variations in research perspectives (Avgerou et al. 1999, Lee 1999, Lyytinen 1999).

Saunders (1998) edited a special issue of the *Information Resources Management Journal (IRMJ)* on the "role of business in IT academic research." This issue included articles that offer a number of suggestions to "make the results of academic (IS) research more consumable" (p. 5). Strategies recommended by the authors in this *IRMJ* issue include: developing closer links to business and technology through sabbaticals and internships in corporations, improving faculty skill levels by realigning tenure and reward systems, revising doctoral program requirements to include business experience, and forming partnerships with professional and discipline based organizations. In addition to this, Benbasat and Zmud (1999) also focus on the style and tone in the presentations of the research, arguing for applying a pragmatic rather than academic tone. In contrast, Lyytinen (1999) takes the view that 'simplifying' the style of complex research would run the risk of deteriorating the potential insights to be gained from this research and that a better approach is to train and accustom IS students to read scientific literature, as is already being done at several European institutions.

The most common prescription for increasing the relevance of IS research is to let practice influence the selection of topics to be studied. However, there are several reasons why the IS research agenda should not be dictated by the issues being confronted by IS executives (Galliers, 1997). This is because IS executives tend to be enamored by the latest technology or moved by the latest management fad or driven to change by the results of surveys that solicit views solely from the IS practitioner community to the neglect of the viewpoints of actual users. Based on this, Galliers (op.cit.) argues that IS researchers should "take account of the views of the practitioner community (including IS users), and be ready to respond to changes in opinion, but at the same time not be swayed by temporary fads. Similarly, we should be proactive, with a view to inform our practitioner colleagues as to the results of our efforts" (p. 148).

Finally, intertwined with the question of practical relevance is also the question of the time frame of the research. While a focus on practical relevance can be seen to foster more short-term

research, several authors argue that it is important to also maintain a long-term perspective to be able to contribute to practice in a proactive way. This is clearly also related to the current explosive discussion conducted by the ISWorld community regarding the turnaround time and publication process of leading IS journals (ISWorld Digest, 1999). While some authors propose that other forms of publication outlets (e.g. archival electronic journals; non-refereed publications) are necessary because the lengthy review process in premier IS journals results in research findings becoming outdated before they are even published, others defend the existing practice by pointing to the need for careful review to ensure quality and also arguing that the value of more basic research in the field is of a more durable nature than the critics seem to assert.

Should IS be viewed as a discipline?

As is obvious from the previous discussion, this question is even more relevant today than ever before. Discussing and addressing it is a means for partly overcoming this crisis of identity or confusion that exists within our academic and professional communities. Also, to truly begin an argument about the "scientific" nature of IS this question needs to be addressed at the outset. Jones (1997) argues that the confusion between three different meanings of the term 'discipline' "may have helped to delay the achievement of a clear understanding of the nature of IS as a subject area" (p. 97). Based on the Concise Oxford English Dictionary, he discusses three different interpretations of the term 'discipline' (p. 98-99):

- Normative (D1): emphasizes the existence of established rules; "seeking to set out, often on the basis of some first principles, what topics are to be included within its boundaries."
- Descriptive (D2): "categorizing what it is that IS teachers, researchers (and in some cases, practitioners) do. The question here is not whether there is necessarily a common perspective, but what is included under the banner of IS, however diverse the practices may be in terms of their philosophical stance."
- Control (D3): discipline as a mechanism for control for the other two approaches; "it is through the operation of D3 institutions, such as professional bodies, academies, accreditation systems and academic journals that the loose collection of individuals in D2 are brought into alignment, with varying degrees of success, with the rules provided by a D1".

The subject matter of IS, though diverse, does constitute a discipline according to all three interpretations listed above. Both IS and non-IS academicians often criticize IS by calling it an *applied discipline*. But clearly the presumption in such a statement is that it is, at a minimum, a discipline. Notwithstanding the naysayers, IS has been clearly accepted as a mainstream academic and university discipline with IS programs existing in a large number of institutions and business colleges, and with specific publication outlets and prestigious conferences held regularly (Banville and Landry 1989). In fact from the academic perspective some evidence is accumulating to support this contention. Using citation analysis and the foundational disciplines of computer science, management science and organization science as a basis, Culnan and Swanson (1986) and Culnan (1987) analyzed IS articles published during 1980-85. They conclude from this analysis that IS "… is emerging as a distinct field of study with its own cumulative tradition" (p. 34). In a similar vein, other authors such as Cushing (1990) and Orlikowski and Baroudi (1991) have concluded that the bodies of work within the IS literature clearly shows significant progress

towards the continual tradition of intellectual development in the IS field, albeit largely dominated by a positivist research perspective. In contrast, based on an analysis of 500 'empirical' articles in six selected IS journals during the period 1980-89, Cheon et al (1993) concluded that while there are definite directions towards which the IS field should evolve, there is no indication of change in *maturity* over this ten year period. These kinds of efforts to assess the IS field accord well with Checkland and Holwell's (1999) contention that "the concept of an intellectual field, or more sharply defined, 'a discipline', implies a *shared concern* to accumulate knowledge in a particular area, to resolve puzzles or problems, and to influence action taken" (p. 32; emphasis added).

Furthermore, although a rare occurrence, some practitioner magazines are also beginning to give due recognition to IS as a distinct discipline. Blumenthal (1998) reports that "according to the Information Technology Association of America (ITAA), one IS position remains unfilled for every 10 IS workers at large and midsize U.S. companies. Across the board, companies are feeling the pinch caused by the lack of qualified IS professionals. Although reliable IS instruction exists in colleges around the world, the idea of the IS degree has yet to permeate public consciousness. To counteract a continued labor shortage, we need to start thinking of IS as a separate path from CS (Computer Science) and encourage more young people to study information management."

Some authors opine that IS cannot be viewed as a discipline because it has no "intellectual core"--it borrows from many "referent" disciplines (King 1993). This rationale is insidious in that if explicitly applied it could very well rule out most natural sciences and all social sciences. Take the example of Physics; it has been greatly influenced by related disciplines such as Mathematics and Electronics Engineering. "The relationship of physics to its bordering disciplines is a reciprocal one… Much of contemporary research in physics depends on the high-speed computer. It allows the theoretician to perform computations that are too lengthy or complicated to be done with paper and pencil. Also, it allows experimentalists to incorporate the computer into their apparatus, so that the results of measurements can be provided nearly instantaneously on-line as summarized data while an experiment is in progress." [Britannica Online 1998]. Other examples of fields that thrive on the insights obtained from their reference disciplines are physical chemistry and geology in the natural sciences and social psychology in the behavioral sciences. Geology for example has been greatly influenced by physics and chemistry. These natural sciences have had a substantive "intellectual" impact on the nature and process of inquiry. Evidently, having reference disciplines is not such a bad thing for IS either. In fact, most social sciences "borrow" substantively from others. In this vein, Kaplan (1964) accurately asserts that "…as science progresses, old partnerships (like natural philosophy or political economy) are dissolved and new ones (like physical chemistry or social psychology) come into being. Nor are the barriers between physical, biological, and behavioral science fixed and impermeable, a fact illustrated by the recent growth of such disciplines as biophysics, cybernetics, and space medicine" (p. 31). In this vein, Banville and Landry (1989) advise members of the IS field to "… not refuse any help from other disciplines given the richness and complexity of their main research object, information systems, and their various facets" (p. 59)[4]. Finally, it should be

[4] For the purpose of making our arguments, we have replaced the phrase 'management information systems' (MIS) used in the original quote with the term 'information systems' (IS).

noted that in this context some authors rightly contend that although reliance on reference disciplines adds to the potential diversity of the IS field, rigorous research should focus on expanding our thinking beyond reference disciplines and even impact the subject matter of reference disciplines (Benbasat and Weber 1996, Robey 1996).

Finally, it can be argued that the IS field encompasses various aspects that together have a symbiotic relationship with each other. Borrowing Hunt's (1992) description[5] of the essential nature of the marketing discipline, it can be similarly asserted that IS is a *university discipline* that aspires to be a *professional discipline* and that accordingly, it has (a) *responsibilities to society*, for providing objective knowledge and technically competent, socially responsible, liberally educated students, (b) to *students*, for providing an education that will enable them to get on the socioeconomic ladder and prepare for their roles as competent, responsible marketers and citizens, (c) to IS *practice* (IS as an *applied discipline*), for providing a continuing supply of competent, responsible entrants to the IS profession and for providing new knowledge relevant to practice, and (d) to the *academy*, for upholding its mission of retailing, warehousing, and producing knowledge, its contract with society off objective knowledge for academic freedom, and its core values of reasing, evidence, openness, and civility. Thus, as a discipline of inquiry, in IS we are concerned with, among other things, the method of inquiry – while as a discipline of practice (professional) we are concerned with (possibly) consistency in methods of application (e.g., methods of analysis, design, implementation, and evaluation). Good application of the former might lead to the latter[6].

Clearly the question whether IS should be considered a science is intricately linked with the question of it being viewed as a discipline. The previous discussion gives us a starting point for understanding the "essence" and place of the IS discipline and its potential status as a science.

The Nature of Science

The ultimate goal of social science or for that matter any other scientific endeavor is to provide a "cumulative body of verifiable knowledge" that allows us to "*explain*, *predict*, and *understand*" the specific phenomena that interest us (italics in original, Frankfort-Nachmias and Nachmias, 1996, p. 8). This is also true of the IS discipline. Based on a version of the natural science model (Burrell and Morgan 1979), Hunt (1983, pp. 17-18 and 1991) maintains that a science as contrasted with other disciplines has some key distinguishing characteristics:

- Any science must have a distinct subject matter, a set of phenomena which serves as a focal point for investigation;
- A science has some means of describing and classifying its subject matter;

[5] We have borrowed the actual wording of this description from Hunt's (1992) paper with some minor modifications. In his analysis of the essential nature of the marketing field, Hunt describes in detail the basis for each of these attributes. His arguments are based on deontological moral philosophy and philosophy of science and are equally applicable to the IS field.

[6] We thank the Department Editor for these insights.

- Every science presupposes the existence of underlying uniformities or regularities among the phenomena that comprise its subject matter. The discovery of these underlying uniformities yields empirical regularities, law-like generalizations, laws, principles, and theories.
- A science utilizes the "method of science" to investigate its subject matter.

As positivism has been the dominant perspective in IS research (Orlikowski and Baroudi 1991), most IS research would fit under the above guidelines. Furthermore, we concur with Cushing's (1990) assessment that "most critics of scientism and functionalism in MIS research are advocating a change in emphasis, rather than a complete abandonment of the scientific method" (p. 39). However, we do recognize that an increasing number of scholars are questioning the use of the 'scientific method' in IS research, arguing that the principles of natural sciences cannot be transferred to the realm of social science involving human actors (Galliers 1985, Klein and Lyytinen 1985). As a result, there is growing interest in alternative research paradigms such as interpretivism (Walsham 1993) and action research (Lau 1997).

Although underlying philosophical differences may lead one to interpret the characteristics of science described above differently, these fundamental attributes provide a good starting point for discussing the nature of the IS discipline. Hence, we will base the ensuing discussion on the above description of science. The reason for this is that the natural science model continues to have a major influence on IS research. Second, the goal of this paper is to address the issue of whether IS can be viewed as a science regardless of philosophical perspective. In doing so, we accept the fallibility of this approach and in the words of Rand (1998) argue that "social science is a science… even if our subjects lie to us, even if they refuse to answer questions and even if they change their minds after they answer the question and even if they intentionally misunderstand what we are trying to get at." Third, clearly much of the argument about the term "science" is a rhetorical one. Our definition and characterization of IS as a science underscores this notion while arguing for rationality and the insistence that all claimants of advancement of knowledge in the field must be called upon to systematically and clearly explain their findings.

The Nature of IS

IS Phenomena

> "*Any science must have a distinct subject matter, a set of phenomena which serves as a focal point for investigation."*

One way to understand the essence of IS and the nature of IS-related phenomena (as contrasted with non-IS phenomena) is to analyze some of the definitions attributed to this phrase. The term 'information systems' can be interpreted differently by different groups. For example, Falkenberg et al. (1998) describe three potential interpretations of the term 'IS': a technical system, a social system, and a conceptual system (an abstraction of the two aforementioned). This represents a challenge in arriving at a precise definition.

A very basic definition of the term IS is based in the meaning of the terms 'information' and 'system'. Information has been defined as "meaningfully processed data," where "meaningful"

implies relevance to a consumer (user) of information and "data" implies raw symbols or facts. A system is a collection of interrelated components that work together for a common purpose. Hence, an Information System is a collection of interrelated components (hardware, software, procedures, people, databases) that work together to "collect (or retrieve), process, store, and distribute information to support decision-making and control an organization" (Laudon and Laudon 1994, p. 8). Thus, information technology (IT) is the mechanism that engenders the activity of gathering and processing data, producing information outputs, and disseminating information to users. Although IT and IS have been used equivalently, especially by practitioners, we consider IT to be a subset of IS (Friedman 1994). In an attempt to incorporate the diversity of the IS phenomenon while limiting the scope of the field, Ein-Dor and Segev (1993, p. 167) define IS as "any computerized system with a user or operator interface, provided the computer is not physically embedded."

In the curriculum development context, Davis et al. (1997, p. 7) delineate the scope of the IS field as follows: "Information Systems, as an academic field, encompasses two broad areas:
(1) Acquisition, deployment, and management of information technology resources and services (the information systems function) and
(2) Development and evolution of infrastructure and systems for use in organization processes (system development). "
Similarly, Cushing (1990, p. 47) defines the IS discipline as "the study of the interaction of IS developers and IS users in the processes of development and use of IS within organizations (p. 47)." Contrasting disciplines that are closely allied because of the use of technology as one key component, Avgerou and Cornford (1995, p. 132) argue that “while computer science is about how computers work (as hardware and software), and software engineering is about building technical systems (ensembles of hardware and software) that meet given specifications**,** information systems is about understanding what is or might be done with these technical systems, and the effects they have in the human/organizational/social world." Another discipline related to both IS and Computer Science is Information Science[7]. However, although IT is the key enabling technology of the information science discipline also, its focus is on the structure and management of large information entities, with documentalists and librarians being key agents (Ingwersen 1996). Table 1 places the definition of IS in the context of other closely related disciplines and attempts to delineate the key contributions of each field. Even though there is a close relationship between IS and the other disciplines listed in the table, clearly, the key difference is in the focus of each field.

*** Insert Table 1 about here ***

It is also interesting to consider the implicit definitions provided by professional organizations as a part of their mission statements. The predominantly academic group, Association of Information Systems (AIS) states its mission as follows: "to advance knowledge of how the use

[7] Ingwersen (1996) provides a thorough discussion on the relationship of information science and its reference disciplines, and the status of the scientific nature of this discipline.

of information technology can lead to improved organizational performance and individual quality of work life." On the other hand, the predominantly practitioner group, Society of Information Management (SIM) asserts that its mission is "to provide international leadership and education in the successful management and use of information technology to achieve business objectives." Clearly, both the academic and practitioner statements contain two key elements: the organizational context and information technology. In addition, it is worth noting that both organizations have a mission to "advance knowledge" (AIS) and "educate" (SIM).

Another way to understand the nature and scope of IS is to consider the impact of reference disciplines. Some authors have argued that IS at a minimum has a support base of three foundational fields: computer science, management science, and organizational science (e.g., Culnan 1986). Others (Benbasat and Weber 1996, Swanson and Ramiller 1993) have also identified economics and cognitive science as additional foundational disciplines from which IS research has continued to borrow. An obvious problem in the IS field is the rapid development of technology and its applications. This contributes to frequent shifts in focus as a result of new areas of deployment, for example electronic commerce and knowledge management. In fact it could be argued that this is one example where reference disciplines such as marketing and organizational science have been directly impacted by the conceptual development in the IS field - especially in the areas of E-commerce, knowledge management and data warehousing/mining.

Apparently, the main difference (if any) between various descriptions of IS relates to an attempt by authors and organizations to limit the scope or bound the field. In other words, although there is some agreement on what subject matter should be clearly excluded from IS, many authors seem to disagree about the topics that should be included within its purview. Notwithstanding these differences, every IS researcher or practitioner would agree that there exist some common elements in all descriptions of Information Systems. Further, even though the study of IS phenomena may be impacted by concepts and theories from numerous referent disciplines, the 'information system' with its implicit enabling mechanism, 'information technology', is always the central subject matter of interest. To the extent that *an information system enabled by information technology within an organizational context* is the focal point of the information systems field, it seems to fulfill this requirement for 'science.'

Describing and Classifying the IS field

> *"A science has some means of describing and classifying its subject matter."*

Beyond defining the notion of IS, several attempts have also been made to classify the subject matter, phenomena, and research streams in the IS field. Cushing (1990) asserts that although IS is a relatively young discipline, there has been substantial progress made in identifying and classifying the subject matter of the IS research. For example, Culnan (1986), Ein-Dor and Segev (1993), Gosain et al. (1997), Lyytinen (1987), and Swanson and Ramiller (1993) have all attempted to either systematically describe the range of IS phenomena being investigated or categorize the various research approaches adopted by investigators in the IS field. As evidenced by the findings reported by these authors, the scope and domain of IS is quite encompassing in its reach and consequently includes a variegated assortment of topics in its subject matter.

Gosain et al. (1997) examined differences in IS research and practice by studying nearly 3,000 articles published over a five year period in four IS journals and five magazines. They found support for the "rapid shifting" of themes in IS research. They subdivided the themes of IS research into four quadrants based on the degree of importance placed by practitioner magazine and academic IS journals on specific topics. They identify inter-organizational systems (IOS) , user training & support, expert systems/natural language programming (NLP), and reengineering as four areas of common interest. The other three quadrants include topical areas such as human computer interaction (HCI), managerial decision making, IS strategy in one category, database and data management, organization issues, computer supported cooperative work (CSCW) in another, and IT impact, marketing, IT applications in the last quadrant. Similarly, Swanson and Ramiller (1993) analyzed the flow of manuscripts (397 of them) into one journal, *Information Systems Research*, and identified eight research themes with each theme having its own set of categories. The eight major thematic areas include CSCW, Decision Support Systems (DSS) / Knowledge-Based Systems (KBS), Systems Projects, Evaluation and Control, Users, Economics and Strategy, Introduction and Impact, and IS research. A broader analysis based on foundational reference disciplines was conducted by Culnan (1987) and reported in a series of articles. She studied the intellectual development of MIS through a co-citation analysis of literature between 1980 and 1985. Her key finding is that the intellectual structure of the IS field can be clustered around five latent factors: foundations, micro (individual) approaches to IS design and use, IS management, macro (organizational) approaches to IS design and use, and IS curriculum.

In contrast to the above classifications of the IS field, Ein-Dor and Segev (1993) focused on the IS phenomenon itself. They identify seventeen major types of information systems and argue that these can be categorized into two major rather fragmented paths of development: the *applied artificial intelligence path* and the *human interface path*. According to the authors, this taxonomy of IS can be used to anticipate the evolution of new systems and consequently of issues that can be addressed through further research.

*** Insert Figure 1 about here ***

Figure 1 illustrates a synthesis of the topical areas that constitute the IS field along with the primary and secondary reference disciplines that have had a major impact in its development. Based on the writings described in the previous paragraphs and the categories reported by Swanson and Ramiller (1993), this figure depicts one classification of the scope and domain of the IS field. Although this chart represents a useful typology there is no need to prematurely circumscribe the subject matter that can be included in the IS field. Kaplan (1964, p. 70) uses the phrase "premature closure" to describe the same notion. Implicit in this statement is the fact that *rational people can potentially disagree about the number and labels of categories or the topics included in each category*.

As evidenced from the previous discussion, it is potentially feasible to describe and classify the subject matter and research approaches in the IS field in different ways. Although these typologies for the IS field will not be completely satisfactory to all people, they do provide a useful analytical

basis for understanding the nature and scope of IS phenomena being investigated. In conclusion, it can be asserted that the scope of the IS field is indisputably broad and somewhat ambiguous. But, tolerating ambiguity engenders "creativity in science" and may not be a bad thing for an evolving discipline like ours (Kaplan 1964, p. 71). As is the case with all other sciences, to the extent that the IS discipline does seek to describe and classify its subject matter (maybe not very well as yet) it would seem to fulfill this requirement.

Underlying uniformities in IS phenomena?

> "*Every science presupposes the existence of underlying uniformities or regularities among the phenomena that comprise its subject matter. The discovery of these underlying uniformities yields empirical regularities, law-like generalizations, laws, principles, and theories.*"

By addressing this criterion, we enter the 'minefield' of diverging philosophical perspectives in IS research. Indeed, this criterion has also caused the largest controversy in our own discussion. The presupposition of the existence of "underlying uniformities or regularities among the phenomena" in general has been and still is a question for debate. The two major strands in this debate have been positivism and interpretivism (Orlikowski and Robey 1991, Walsham 1995b). Being rooted in the natural sciences, the positivist perspective is based on the ontological assumption that there exists an objective social reality that can be studied independently of the action of the human actors in this reality. The epistemological assumption following from this is that there exist unidirectional cause-effect relationships that can be identified and tested through the use of hypothetic-deductive logic and analysis. As the criterion discussed here also is based on the natural science model, it is easy to see how research conducted in the positivist perspective falls in line with this form of scientific inquiry.

In contrast, the interpretive perspective is based upon the ontological assumption that reality and our knowledge thereof are social constructions, incapable of being studied independent of the social actors that construct and make sense of this reality. Instead of seeking unidirectional cause-effect relationships, the focus according to this perspective is to understand the actors' view of their social world. Thus, the discovery of "empirical regularities" and "law-like generalizations" becomes problematic when viewed from this perspective. In the interpretive perspective, Walsham (1995a) presents four different types of generalization: the development of concepts, the generation of theory, the drawing of specific implications, and the contribution of rich insight. According to this perspective, generalizations should be viewed as tendencies rather than predictions, i.e. as "explanations of particular phenomena derived from empirical interpretive research in specific IS settings, which may be valuable in the future in other organizations and contexts" (ibid. p. 79).

While acknowledging the importance of this debate, we believe that in practice this often can be reduced to a matter of rhetoric. There is a tendency to present the various perspectives in 'black and white', so that the description of positivism as applied by interpretivists often do not correspond to the actual views of the researchers in this paradigm and vice versa. In debating these issues, the proponents of the different perspectives in practice often can be found to be more open to each other's arguments than one may believe by looking at the debate in the literature. For example,

many positivists today will acknowledge the contextual embeddedness of their research. In general, there also seems to be a trend towards mutual acknowledgment of these two perspectives (Benbasat and Weber 1996, Orlikowski and Baroudi 1991, Robey 1996). In this vein, it has been reported that there are an increasing number of interpretivist studies being published in major IS journals (Walsham, 1995b).

It is also important to note here that the positivist and intepretivist perspectives actually comprise several varying perspectives that should be seen as constituting a continuum rather than a dichotomy. The many research perspectives applied by leading scholars in social science (Morgan 1983) may also serve as examples of the many possible combinations of ontological, epistemological and methodological assumptions and considerations that are possible for IS research. Furthermore, the different perspectives are also to be regarded as dynamic concepts, that are being developed and refined as part of the scientific discourse. As an illustration, Hirschheim (1985) traces the development of IS epistemology through positivism, anti-positivism, neo-positivism and post-positivism.

Related to the question of interest in this paper, we feel that it is most important to focus on the common ground rather than conflicting issues. From both perspectives, the ultimate goal of IS research (or any other for that matter) is to produce some form of knowledge that has relevance outside the context of the original research setting. The difference lies in the claims made about the status of this knowledge, i.e. law-like generalization vs. tendencies (Walsham 1995a). Also, not many IS researchers would likely deny the fact that clearly *some* progress has been made towards studying and identifying regularities in IS phenomena and *some* uniformities have been found. For example, the modified Technology Acceptance Model (TAM) is such a research achievement in point (Davis et al. 1989). Rather than reducing the argument to the issue of whether "the" scientific method is appropriate for IS, the discipline can benefit by applying scientific principles to devise and revise our methods and techniques of investigating and validating findings, and engender the advancement of knowledge beyond its application to a very specific context. Thus notwithstanding differences in philosophical perspectives, one can conclude that the general aim of theory development and knowledge accumulation in IS research is a key argument favoring the status of IS as a science.

IS Research Methodology

> "*A science utilizes the "method of science" to investigate its subject matter*."

Frankfort-Nachmias and Nachmias (1996 p. 23) state that "the methodology of the scientific approach serves the purpose of providing rules of communications, rules for logical and valid reasoning, and rules for intersubjectivity (the ability to share knowledge). Social science is not united by subject matter but rather by their research methodology." In true scientific spirit, these rules "are constantly being improved as scientists look for new means for observation, measurement, inference, and generalization" (ibid. p. 13). Even though conditions under which a study is done may change and "newer circumstances may emerge" (Galliers 1985), the benefit of the scientific method lies in its *logic of justification* - a common set of procedures on which a

science and its investigators accept or discard hypotheses or criticize new knowledge claims of peers (Kaplan, 1964).

Kaplan (1964, pp. 18-19) argues that "the" *scientific method* is to a large extent an ephemeral concept and asserts that the word "methodology", like the words "physiology", "history", and "logic", "… is also one which is used both for a certain discipline and for its subject-matter." He goes on to explain that *methodology* is "the study - the description, the explanation, and the justification of the methods, and not the methods themselves. Often when we speak of the 'methodology' of say, economics, we refer to the method or methods used by economists (more likely, some particular school of economists)". Further, Kaplan asserts that *techniques* are "the specific procedures used in a given science, or in particular contexts of inquiry in that science" (ibid. p. 19). Thus, *methods* are "techniques sufficiently general to be common to all sciences, or to a significant part of them. … Thus, methods include such procedures as forming concepts and hypotheses, making observations and measurements, and making predictions" (ibid. p. 23). Accordingly, "… the objective of *methodology* "is to help us to *understand*, in the broadest terms possible, not the products of scientific inquiry but the process itself" (ibid. p. 23). It should be noted that we emphasize these concepts and their meanings because a number of authors appear to equate 'methodology' with 'method' and 'methods' with 'techniques'.

Methodology has been an area of discourse in the IS field for many years. During the 1984 IFIP WG 8.2 colloquium, the question of which methods should be applied in IS research was one of the key issues. More recently, the question of "methodological pluralism"[8] has also been addressed as part of the general debate of diversity in IS research endeavors (Benbasat and Weber 1996, Robey 1996). In brief, the two strands in this debate consist of those who see diversity as a threat to the further development of the IS field, resulting in a lack of common focus and lack of accumulation of knowledge; On the other hand, there are those who argue that diversity both regarding issues and methods actually should be seen as a means for further advancing the field.

Regarding the relative status of the different methodological approaches, there also seems to be a tendency towards reconciliation. For example, there have been several attempts to combine the different philosophical perspectives (e.g., refer Lee 1991). Today, methodological diversity is greater than ever before, as illustrated by the 1997 IFIP WG 8.2 conference (Lee, Liebenau and DeGross 1997). The quality and diversity of IS research has increased with the development of the IS field while the requirements for rigor and versatility of methods have sharpened both for quantitative and qualitative research studies (Benbasat and Weber 1996). Both Cheon et al. (1993) and recently Avgerou et al. (1999) report finding empirical support for the increasing diversity of research strategies and techniques in the IS field. In this context, we agree with Kaplan (1964) when he argues that, "… it is less important to draw a fine line between what (research technique) is 'scientific' and what is not than to cherish every opportunity for scientific growth. …The more realistic danger is that some preferred set of techniques will come to be identified with the scientific method as such. The pressures of fad and fashion are as great in science, for all its logic, as in other areas of culture." (p. 28).

[8] The authors cited here may actually mean pluralism in the techniques and methods used in IS research.

We accept the notion put forth by Churchman (1971, p. 12-13) when he argues that any scientific endeavor entails intellectual understanding and that means an ability to inquire into the nature of things by using inquiring methods that force us to rethink and evaluate the process of research itself. Pluralism of research methods and techniques coupled with constructive but skeptical criticism of knowledge claims is a sound goal for the IS field. The main point relative to this criterion is that the application of different research techniques in IS research today is not incongruent with the fundamental goal of science: to add to the state of knowledge and understanding of IS by studying IS phenomena with a set of accepted criteria for conducting and communicating findings while assuring their validity.

Summary and Concluding Remarks

In this paper we have addressed the question of (a) whether information systems (IS) should be viewed as a discipline and (b) whether IS should be viewed as a science. This has been done through an examination of criteria derived from the natural sciences. From this we have concluded that IS is a science, i.e. a scientific discipline in contrast to purportedly non-scientific fields. Notwithstanding our (the authors) differing philosophical perspectives, we have argued that scientific principles can be of value (and are actually being applied) in IS research and that investigators are using a multitude of research techniques depending upon the nature of IS phenomena being investigated. It is also worth noting that the very fact that this question is being raised and discussed is evidence of the scientific nature of IS research. After all, "members of any scientific field, and particularly those belonging to fields struggling for recognition such as MIS, have to worry about the social and scientific status of their discipline" (Banville and Landry 1989, p. 48). Understanding the fallibility of our conceptual models, theories, and research methods while continuing reflection and introspection is an essential practice for any science. However, there are some limitations embedded in the criteria chosen to analyze the scientific nature of IS in this paper. An interesting question for further inquiry is whether these criteria are "relevant" and "complete" – that is, could we suggest other criteria that are better suited to the IS field?

Ultimately, the question of whether IS can be termed a science may be a matter of *rhetoric*. The answer clearly depends on whether we agree that the IS field does include a systematic body of organized knowledge based upon investigation of discernible phenomena that are studied using diverse but rigorous scientific methods akin to other scientific disciplines. Additionally, if one believes that applying the term science requires replicability across researchers and subjects, it may still be possible to argue in favor of calling IS a science, although the term may be less appropriately applied under certain philosophical orientations. Much has been made by some authors of the fact that IS derives its models and theories from other reference disciplines. We have argued that this is not very different from other social sciences such as psychology or the natural sciences such as physics that are also influenced by their reference disciplines.

One indirect implication of our analysis is the conclusion that there is (a continuing need for studies that inquire into the scope and state of the IS field. This could include both longitudinal studies of IS journals and other bibliographic references, as exemplified by the recent study reported by Farhoomand and Drury (1999), and critical analysis based on the assessment by key actors in the

field like the Watson (1999) study. In doing this one should also take into consideration how different geographical variations in socioeconomic context can lead to regional differences in the nature of the field, as illustrated by the study by Avgerou et al. (1999) where they reported finding variations in the academic field of IS within Europe and as compared with North America.

We are obviously upbeat about the "IS discipline" for both economic (our jobs depend on it) and philosophical reasons. However, we are also troubled by the fragmented nature of our field and in some sense this paper has been an avenue for arguing that we do need to have stronger validation of the ways in which we conduct inquiry and verify knowledge claims without being dogmatic about what techniques are amenable to scientific inquiry in IS. Thus, merely adopting the labels embodied by an ephemeral scientific method is not enough. Good scientific inquiry must be credible and the knowledge-claims defensible within the context of the research effort. Clearly, the key lies in applying the rigor of science to both the process and product of inquiry and to the assessment of knowledge-claims. In addition, by defining the conceptual domain of IS as independent of "IT" per se, we attempt to separate ourselves from others who argue that technological imperatives only define our field. Furthermore, logically affirming that the IS discipline merits the designation of a 'science' has four critical implications for the IS academic and professional community. First, this status reiterates a commitment to a continuing emphasis on adopting scientific principles and practices for conducting inquiry into IS phenomena. Second, this status could result in some cessation of questions about its (the IS discipline's) grounds for further existence as a unique academic field while raising the status and prestige of the discipline. In addition, it strengthens the arguments available for defending against outside criticism and potentially reduces the impact of resource rivalries and competitive threats to its existence as a discipline. Third, there is something to be said about the importance of increasing the *self-esteem* of the members of the IS community and other positive effects this might bring. Lastly, there is abundant historical evidence to show that scientific disciplines are best situated to developing a cumulative tradition of fundamental research that builds on previous models/theories and knowledge of IS phenomena. Considering the relative youth of the IS field, there is obvious difficulty in showing much "cumulativity" of knowledge. But, like Hunt (1991, p. 301) we would argue that even though our field's foundations are tentative (as they were with say Newtonian Physics), new scientific knowledge can be built on such fallible foundations.

Finally, as a "thought experiment" let us consider what could happen if we concluded otherwise, that is, IS is not a scientific discipline and this also becomes the generally accepted view. What would have been lost cannot be expressed in serious terms except to assert that the IS community would have lost their common identity and ground for existence. We would argue that this would lead to a reductionist view of the role of information systems in organizations and society, as the focus would be shifted entirely to how the technology could support existing practices and business processes. We would be foregoing proactive research such as advocating how IS can and should be used to leverage performance and competitiveness in organizations, enhancing individual performance and well-being or producing positive societal effects. The development and use of IS would become more restricted by the existing frames of the referent disciplines, rather than being able to actually impact these disciplines further. We believe that methodological and philosophical diversity does not preclude IS researchers from making scientific inquiries into the fundamental nature of IS phenomena. Without sounding pedantic, it is worth reiterating the meaning of the term

science described in the opening quote. IS scholars must continue to pursue "knowledge," to "know" more about IS phenomena and the context in which they occur, and pursue "knowledge" and "understanding" wherever it may lead, whilst assuring its veracity through the use of a "scientific method" and critical peer review.

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