MANAGEMENT INFORMATION SYSTEMS: ARE WE TEACHING A SCIENCE?

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ABSTRACT

If a field of knowledge is defined by its communication system among scholars, then answering the question, "Is the field of Information Technology a science?" must be answered by examining its research paradigms.

Keywords: Research paradigms, frameworks, philosophy of science

INTRODUCTION

The streams of research encompassing the field of information systems technology and application suffer from the same identity crisis that has plagued other areas of social science. The older, more established social sciences, labeled sociology and psychology, along with their application-specific variants labeled economics, anthropology, and political science are fraught with a blurring of the boundaries they try to define that separates them from each other and from other disciplines.

Information Systems (IS) is the neophyte application-specific variant that takes the theories and models developed in sociology and psychology and modifies or re-labels them to fit a business application while utilizing new technological tools. If IS research were defined to be only concerned with the technology aspects of the field we would not have these links to the social sciences. Our links would be to electrical engineering, computer science, process control, and engineering fields of design related to anatomical requirements for humans operating equipment. But IS is more broadly defined to be associated with commerce and the interaction of the technology with the person and the business process. This sways the field back into the area of social science. We are not proposing that IS is destined to implode into becoming merely the subject of a two or three week study unit as part of a sociology course, but rather that in order to distinguish ourselves from the other disciplines we need to address the defining differences that make IS research unique. However, before we can define what makes our discipline different from other disciplines, we need to first agree on what the field is and what are the areas within the discipline.

Auguste Comte, the titular founder of sociology, put forward an analytical view of the progress of knowledge that describes the development of science as a gradual accumulation of pieces of knowledge. This view of the progress of knowledge is in accordance with the way science has actually progressed; the fragmentation we see in all scientific development is evidence of that. This is very true in IS research.

IS as a research field has only emerged within the last 30 years. In reviewing the literature, there is no shortage of attempts to define the field, establish boundaries, standardize terminology, set rules for research and all the other activities and characteristics necessary to declare ourselves a

science. Unfortunately, consensus has still eluded us. This diversity, according to Benbasat and Weber (3), can be problematic to defining IS as a discipline. The continuance of diversity in the field serves to prevent the development of common paradigms that are necessary to be considered a science. According to Weber (25) disciplines attain a relatively stable place and identity among other disciplines only when they develop at least one powerful paradigm and that paradigm is accepted as being unique to the discipline.

RESEARCH QUESTION AND METHODOLOGY

In this paper we are reviewing the evolution of research paradigms in the information systems field so that we may delineate those paradigms that are still viable and identify any conflicts among them. Additionally there is an attempt to also evaluate the effectiveness of the paradigm to distinguish the field from all others. The first problem encountered is that there isn't an accepted definition of what constitutes a paradigm. Researchers define their attempts to differentiate the IS field by using terms such as frameworks, taxonomies, portfolios, and typologies in addition to the term paradigm. It is our belief, however, that in the IS research context, all of these terms are synonymous with paradigm. By agreeing to standardize terminology, it is hoped that researchers could devote their energies to developing that defining paradigm Weber feels is necessary to establish IS as a separate research discipline.

In the next section of this paper we will define "paradigm" and discuss why paradigms are a logical means of studying the evolution of IS research. The following section draws the parallels between paradigms and frameworks, taxonomies, typologies, and portfolios. Then we will present a tabular analysis of a number of significant frameworks developed by various researchers over the last thirty years and comment on their usefulness, conflicts with other frameworks, and their ability to differentiate the field. Finally, we will discuss conclusions and areas for future research.

In order to accomplish our objective, we performed a literature review of the leading journals that focus on IS issues. According to Holsapple, et al. (11) examining the communication system among scholars constitutes a means of identifying the scope of the field. We reviewed the last thirty years of articles appearing in what were, and in some cases are, the emerging journals of scholarly research in the field. Our review has been limited to conceptual research frameworks; frameworks that relate research methods to the focus or stages of research have not been included in this study. Although our effort could not be considered exhaustive, we believe that the most significant frameworks, paradigms, etc. were reviewed. A thirty-year time frame was considered proper because this parallels the time of the emergence of IS as a research field.

THE PARADIGM AS A DEFINER OF SCIENCE

In the philosophy of science, a paradigm is defined as the set of theoretical assumptions about a subject and laws and techniques for the application of these assumptions that is accepted by the scientific community researching that subject. The originator of the concept, Thomas Kuhn, described paradigms rather vaguely as "models of scientific activity … providing particular coherent traditions of scientific research." (15, page 10). He addressed this vagueness in his 1969 postscript, wherein he stated that the term "paradigm" was actually used in two different senses. The first meaning of the word is the sociological notion of the shared values and techniques of a research community. It also denoted exemplary past achievements; though Kuhn

suggests that this second meaning is the deeper of the two, it is the first meaning that is of interest in this analysis.

In Kuhn's view, the history of science consists mainly of two kinds of activities: normal science and revolutions. Kuhn considered paradigms as the central block of normal science and described the movement of the scientific community from paradigm to paradigm as the only reality. The paradigm guides the whole group's research, and it is this criterion that most clearly proclaims a field of science (15, page 22). During the period of normal science, the paradigm guides the community's research and there is cumulative growth in knowledge. The transition to a newer paradigm changes the scientific community's view of the field and its methods and goals (15, chapter VIII). Revolutions mark the transition between one period of normal science and another; they occur when a paradigm is overthrown and replaced. When the exiting paradigm starts to "blur", there is no cumulative growth in knowledge. This stage of crisis continues until transition to an alternate paradigm is complete; then the profession changes its view of the field, its methods, and its goals.

The concept of "paradigm incommensurability" has been the subject of many debates in the social sciences. If we accept the notion of incommensurability, major theories are incomparable since we have no way of translating between these theories. It can be argued that no direct translation is necessary between two theories for them to be compared. In fact, it is the interpretation of data by these two theories that need to be compared and it is possible to do that, by Kuhn's own account of the movement from Newtonian Physics to Einstein's science. Further, if different paradigms and their contents really were incommensurable, it would certainly go against what scientists conceive of themselves as doing. As Kuhn (15, page 171) states, scientific advance happens when there is "evolution-from-what-we-do-know".

FRAMEWORKS AS PARADIGMS

A conceptual framework consists of a selection of concepts and relations among them, grouped so as to enable its users to easily see the major concepts simultaneously in their relation to one another (14). More simply put, a framework is a conceptual model for organizing thought and discussion about IS (17). The framework provides a well-defined, formal "model", which encapsulates our knowledge of the research area and matches up with our real-world experience. It structures our understanding of the field, providing for us a guideline to interpret data and ask questions, to do further research. According to Gorla (9), a research framework should be concise and complete, represent research issues that are mutually exclusive and identify research areas that need to be explored.

A framework helps identify research issues and the relationships among these issues (9). According to Kochen (14), the purposes of a framework are to partition real world experience and ideas, and organize the knowledge that is assimilated through the interaction of experience and ideas. These (experiences and ideas) are dependent on the time period in which the framework is created. This is especially true of frameworks in the field of IS, which is a fast developing and rapidly changing field. Inspecting the different IS research frameworks and taxonomies, a distinction is immediately evident between the early and later frameworks. The early frameworks started with a definition of what IS is or must be and then proceeded to state

the areas in which research has been done, is being done and needs to be done. It is based on this definition or perspective of IS activities that the researcher separates out various areas of research in IS, creating the dimensions for the framework. In attempting to channel the research in the IS area, these frameworks are more normative in nature. Given that IS was a budding field at that time, this approach of starting with a definition is quite logical. Later works tended to list and classify the research that has been done in the IS area and provide interpretations on the direction and nature of such research.

Truth at any time is dependent on the nature of the observer, which is in turn dependent upon the observer's own experiences and future goals; this is the notion of "historicity". The framework can be seen as a statement of truth of the nature and content of IS research by the creator of the framework. Therefore, it is clear that the intellectual leaning and research interests of the creator of the framework will affect the dimensions and the inclusiveness of the framework. Further, the goal of the researcher in creating the framework also dictates the dimensions of the framework.

Kochen (14) has also provided a classification of frameworks: superficial taxonomies, tentative definitions and in-depth conceptualizations. However, Kochen does not provide a description of these different classifications. We would argue that these are different stages in the development of a framework. Based on a tentative definition of the topic under study, the scholar creates a taxonomy that serves to clarify the definition and identify the major dimensions. These dimensions then provide the basis for the partitioning of the subject under study into meaningful chunks that have some cohesiveness. These dimensions also relate to some aspect of measurement in IS research, as managerial functions or focus of the research (19). This partitioning then contributes to a detailed analysis of the field and to identifying links and locating gaps, which otherwise would not have been evident.

It is interesting to note that even as Kochen argues against frameworks, he ends up providing a classification which suggests a range of problems for IS researchers to investigate and lists supporting theories from other referent fields with which to investigate these problems. This classification appears similar to the framework that Kochen has defined. Similarly as Keen (13) denounces frameworks as too easy to generate and as untestable, and detracting from serious research, he too provides a classification based on the nature and impact of the functions that IS supports in organizations. He would rather use the term "portfolio" to denote this classification, but in partitioning concepts based on certain dimensions and organizing those, he too, has by definition provided a framework.

The following table demonstrates the breadth of diversity in IS research paradigms by summarizing a sampling of significant paradigms/frameworks advanced by various researchers over the last 30 years. It is not an all-inclusive list by any means but demonstrates the problem of diversity in the field.

Year	Authors	Dimensions	Comments
1971	Gorry & Scott Morton (10)	Focusing on decisions made in organizations and the role of information systems as a support tool for decision making, stages in decision-making and the	A clear boundary is set between what MIS should be and should not be. Since both the dimensions of the framework can be thought of as a continuum rather than

Year	Authors	Dimensions	Comments
		structure of problems are identified as dimensions.	as discrete points, it is not very easy to identify the system to be used. Focus is limited to one aspect of IS.
1973	Mason & Mitroff (18)	The components of an IS: psychological type of the individual, classes of problems, method of evidence generation, organizational context of problem and mode of presentation of evidence	Manipulation of these five different variables that comprise information systems creates diverse information systems, which need to be studied. The authors emphasized that within each of the five components, there is a plurality; this argument indicates the need for additional reference disciplines. The focus is on defining the different information systems that can be used in problem solving and thus the framework is not comprehensive.
1977	Dickson, Senn and Chervany (7)	Three sets of independent variables – the attributes of the decision-maker, the decision environment and the characteristics of the information system – impact the dependent variable, decision effectiveness.	By identifying decision effectiveness as a final dependent variable, this work introduces the notion of evaluation of the information system. This was not an attempt at defining the field of IS research.
1980	Ives, Hamilton and Davis (12)	Includes 3 information systems environments (operations, development, and user), 3 information systems processes (use, development, and operation), and the IS subsystem itself all existing within an organizational and an external environment.	A systems analysis and design focus that no longer fits many of today's areas of research.
1980	Nolan and Wetherbe (20)	Combines input-process-output sequence of transforming data into information further subdivided using other researcher's categorizations of outputs, processing, and organizational environment.	A dated analysis that doesn't reflect many of the current areas of research.
1982	Bariff & Ginzberg (2)	Process (design of MIS, use of MIS, management of IS function) by level of analysis (individual, group, organizational, and societal).	Focuses on behavioral research and recognizes roots in the reference fields. Does not differentiate the IS field from other research disciplines.
1989	Gorla (9)	MIS activities and associated referent disciplines are identified; these serve as the basis for classification of research in information systems into a 5X5 matrix.	Previous attempts to classify IS research have indicated alliances to different research disciplines. This framework re-emphasizes the inter-disciplinary nature of IS research.
1992	DeLone and McLean (6)	A one-dimensional categorization of IS success – system quality, information quality, use, user satisfaction, individual impact, and organizational impact.	Not inclusive enough to successfully integrate the IS research field.
1993	Swanson and Ramiller (23)	Themes in IS research were identified by surveying submissions to Information Systems Research.	Since this is based on survey of research submitted during a time-period, the themes that are identified reflect the issues that are important in that period. Further, the journal welcomed articles based on the social sciences and thus the themes may exclude articles based on other disciplines. However, the thematic

Year	Authors	Dimensions	Comments
			areas identified cover all current topics of research.
1996	Brancheau, Janz and Wetherbe (4)	Categorization of key concerns from a polling of members of an MIS professional organization.	Practitioner oriented, not reflective of current or future academic research areas.

CONCLUSIONS

The purpose of this research effort was not to provide an all-inclusive analysis of research paradigms within the field of IS. It is intended to show the diversity that exists within the field and argue that because of this diversity there has been a failure of IS researchers to be able to come together and properly form consensus. With the lack of a consensus, a dominant paradigm and other common paradigms cannot emerge. Without a paradigm emerging, it is problematical for IS to define itself as a science.

The paradigms described in the previous table are examples of a number of different paradigms advanced at some point in time by different researchers. Many of these paradigms were developed by reviewing dissertations, published articles, or journal submissions. By their very nature these are dated and can lose meaning and relevance as new technologies, methods and understandings emerge. Similar to Lakatos's degeneration of a research programme, these dated paradigms should be abandoned once there are supplanted by a newer categorization or paradigm. The newest paradigm developed by this method is the Swanson and Ramiller paradigm; but it too has become somewhat dated.

The other paradigms that were not developed by categorizing articles, etc., with the exception of that proposed by Mason & Mitroff, don't claim to be all-encompassing paradigms but rather frameworks for research in specific areas. The Mason & Mitroff paradigm in actuality has its own limitations as identified by Ives, Hamilton, & Davis (12). None of these paradigms can claim to be the dominant paradigm we are searching for because they do not represent the entire field of IS research. However, they can fit the category of other common paradigms. This form of diversity in the discipline is healthy as long as there also exists some order; order that comes from the adoption of a dominant paradigm.

We would suggest that the Swanson & Ramiller paradigm be revalidated with more current data. The original paradigm was developed from submissions to a journal between 1987 and 1992. With the built-in delays in the submission process this research was probably conducted starting in 1985 and continuing through 1991. This validation could give rise to new categories and possibly new themes; and maybe result in eliminating some obsolete areas. This modification of categories would not be considered a "revolution" in the Kuhn sense. It would just be normal science. If this effort resulted in validating the Swanson and Ramiller paradigm, it would reinforce the idea of adopting it as the dominant paradigm. It would then serve as a standard for defining the field of IS research while at the same time differentiating IS from other disciplines. Then, at least according to Weber, we will establish ourselves as a science.

REFERENCES

1. Bariff, M. L. and Ginzberg, M.J. 1982. MIS and the Behavioral Sciences: Research Patterns and Prescriptions. *Data Base*, Fall 1982, pp.19-26.
2. Benbasat, I. and Weber, R. 1996. Research Commentary: Rethinking "Diversity" in Information Systems Research. *Information Systems Research.* 7:4 pp. 389-399.
3. Brancheau, J.C., Janz, B.D. and Wetherbe, J.C. 1996. Key issues in Information Systems Management: 1994-95 SIM Delphi Results. *MIS Quarterly*, June 1996, pp.225-242.
4. DeLone, W.H. and McLean, E. R. 1992. Information Systems Success: the Quest for the Dependent Variable. *Information Systems Research*, 3:1 (1992), pp.60-95.
5. Dickson, G.W., Senn, J.A. and Chervany, N. L. 1977. Research in Management Information Systems: The Minnesota Experiments. *Management Science*, 23:9 (May 1977), pp.913-923.
6. Gorla, N. 1989. Identifying MIS Research Issues Using a Research Framework. *Information & Management*, 17 (1989), pp.131-141.
7. Gorry, G. A. and Morton, M. S. 1971. A Framework for Management Information Systems. *Sloan Management Review*, 13:1 (1971)), pp.55-70.
8. Holsapple, C.W., Johnson, L.E., Manakyan, H., and Tanner, J. 1994. Business Computing Systems Research: Structuring the Field. *Omega: The International Journal of Management Science*. (24:1), pp. 69-81.
9. Ives, B., Hamilton, S., and Davis, G. B. 1980. A Framework for Research in Computer-based Management Information Systems. *Management Science*, 26:9 (Sept 1980), pp.910-934.
10. Keen, P. 1980. MIS Research: Reference Disciplines and a Cumulative Tradition. *Proceedings of the First ICIS*, December 1980, pp.9-18.
11. Kochen, M. 1985. Are MIS Frameworks Premature? *Journal of Management Information Systems*, 2:3 (Winter 1985-86), pp.93-100
12. Kuhn, T.S. 1996. *The Structure of Scientific Revolutions.* The University of Chicago Press: Chicago, IL.
13. Mason, R.O. and Mitroff, I. I. 1973. A Program for Research in Management Information Systems. *Management Science*. 19:5 (January 1973), pp.475-487.
14. Mason, R.O. and Swanson, B. 1982. Measurement as an MIS Foundation. *Data Base*, Fall 1982, pp.27-29.
15. Nolan, R. L. and Wetherbe, J.C. 1980. Toward a Comprehensive Framework for MIS Research. *MIS Quarterly*, June 1980, pp.1-19.
16. Swanson, E. B. and Ramiller, N.C.. 1993. Information Systems Research Thematics: Submissions to a New Journal, 1987-1992. *Information Systems Research*, 4:4 (December 1993), pp.299-330.
17. Weber, R. 1987. Toward a Theory of Artifacts: A Paradigmatic Base for Information systems Research. *Journal of Information Systems*. Spring. pp. 3-19.