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A Citation Analysis of the Evolution and State of Information Systems within a Constellation of Reference Disciplines^{1, 2}

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Abstract

For the past two decades notions of “cumulative tradition” and “reference disciplines” have been a significant part of the introspective debates on the IS field. We provide an

¹ Detmar Straub was the accepting senior editor. This paper was submitted on June 5, 2004, and went through three revisions.

² We are indebted to Detmar Straub, and three anonymous reviewers for their many insightful comments on earlier drafts of this article.

exploratory test on these notions using sociometric analysis. In doing so, we extend the work of Culnan and Swanson originally carried out about 25 years ago. By using the concept of a “work point” and “reference points” to identify where an IS article is published and the extent to which it draws from or contributes to other disciplines, we can position research in the IS field. First, a quantitative analysis of over 72,600 citations spread across 1406 IS articles in 16 journals over the period 1990-2003 reveals a distinct trend toward a cumulative tradition, a changing mix of reference disciplines, and a two-way relationship between IS and some of the more mature disciplines. Second, post-hoc content analysis provides a glimpse of how IS work is being utilized by other disciplines. Overall, our analysis indicates that IS is taking up a more socio-technical persona, building upon its own knowledge base, and repaying its debts by contributing to other disciplines. We interpret the movement towards building a cumulative tradition, and informing work in other disciplines as positive, as we strive toward being part of an intellectual network and establish centrality in areas that matter to us most.

Keywords: Introspective analysis, Sociometrics, Management Information Systems, IS research, Evolution of IS, Citation analysis, Content analysis, Exploratory research

Introduction

The terms “cumulative tradition” and “reference disciplines,” coined by Keen at the first ICIS conference in 1980, have been important components of the vocabulary and conduct of IS scholars for the past two decades (Keen, 1980). Keen underscored that the field of Information Systems (IS) lacks many of the qualities considered by academics to truly be considered a stand alone discipline. Furthermore, Keen presented a series of necessary steps that IS researchers must take to make certain the field is not consumed by a more clearly defined “classical” area, such as Accounting. Some scholars have since considered this quest to become a classical research area with its own cumulative tradition to be an essential objective for the continuation of the field.

Broadly speaking, there is disagreement among experts in the field as to whether IS is making progress toward such goals. As a comparatively young field, IS research tends to draw from a variety of reference or foundational disciplines that are considered more mature. These are thought to contribute toward the development of IS research by providing theoretical and methodological inputs (Banville and Landry, 1989; Robey, 1996). Some consider this rich diversity presented by numerous foundational fields a cause to celebrate and rejoice (Robey, 1996). Other scholars have lamented that IS lacks a cohesive framework, and is at best a confused adhocracy (Benbasat and Weber, 1996; Checkland and Holwell, 1998), and that perhaps the diversity of the IS field inhibits development of a strong cumulative tradition of its own (Cheon et al., 1992; Culnan and Swanson, 1986). Optimistically, it has been suggested that perhaps the field has matured to the extent that not only does it have a cumulative tradition, but it should also be giving back to other disciplines (Baskerville and Myers, 2002). Seen this way, IS is not at the end of the intellectual food chain, but instead at the center of the network of knowledge pertaining to information systems and its effective deployment in a social context (Baskerville and Myers, 2002).

Our objective in this study is to test an exploratory model on the aforesaid notions of reference disciplines, cumulative tradition, and contribution to other disciplines, and

assess whether progress has been made toward such objectives. We do so using sociometric techniques that attempt to quantify the relationships that are embedded in written and published works (Pritchard, 1969). This family of techniques, along with qualitative analysis, is used to provide a reasonable response to the following questions:

1. How has the field evolved with respect to drawing from reference disciplines?
2. How has the field evolved with respect to creating its own cumulative tradition?
3. How has the field evolved with respect to contributions to other disciplines?
4. How, if any, are IS contributions being used by research in other disciplines?

These questions are fundamental to our field. They demand a level of introspection that goes beyond speculation or pontification. Furthermore, they benefit from ongoing investigation, as they arguably reflect the evolving maturity of our field. Implicit in this is *our assumption* that mature fields depend less on other disciplines for their inputs, have internal consistency and a cumulative tradition within their own work, and are recognized for their intellectual contributions to an area that other disciplines can draw upon.³

In examining these questions, we extend the original Culnan and Swanson (1986) citation analysis of approximately 25 years ago. We extend the analysis broadly, both quantitatively and qualitatively. On a quantitative note, Cheon et al. (1992) replicated the Culnan and Swanson (1986) study over 15 years ago. Since then, a number of technological innovations have transformed the business environment and ultimately challenged the nature of our field (Vessey et al., 2002). This dynamism leaves many questions unanswered. Is the field more fragmented? Is it creating an intellectual engine that is being drawn upon by other disciplines as they too recognize the IS component pervading their fields? On a qualitative note, a content analysis of work published in other disciplines allows us to overcome to an extent the shortcomings associated with pure sociometric analysis. While the Cheon et al. (1992) study and other conceptual work (see for instance Baskerville and Myers (2002)) have proposed that IS work might be utilized by other disciplines, it is not entirely clear whether IS research has served (or serves) as a superficial boundary object or has played a central role in informing work in other disciplines. Content analysis can add more detailed insights on IS contributions to other disciplines (where applicable) than what is uncovered through sociometric tests alone.⁴ Thus, by having the advantage of prior data, and using an amalgam of quantitative and qualitative techniques, we can provide a truly evolutionary perspective of the maturity of the IS field and its contribution to its intellectual network.

The balance of the paper is as follows. First, we provide a brief background on prior work in the evolution of IS and some reflection on changing trends over the past two decades. Drawing upon this background and changes IS has witnessed since 1990, we

³ For instance Ferraro et al. (2005) citing the case of Economics as a mature discipline suggests that: "In academia, citation patterns show that Economics enjoys status and, indeed, dominance. Economic ideas are increasingly prominent in political science as well as Organization Science. And Economics literature is cited more frequently in other social sciences literature, even as in Economics literature itself other social sciences are cited much less frequently" (p. 10/11). See also Baron and Hannan (1994), Green and Shapiro (1994), Pfeffer (1997), and Posner (2003) for related arguments. Bazerman (2005) in his response to Ferraro et al. (2005) provides additional arguments to complement Ferraro et al.'s (2005) perspective, but this literature is in agreement with the basic observation.

⁴ We are grateful to a anonymous reviewer for suggesting that we perform a post-hoc content analysis

present a model concerning the emergence of IS as a discipline. We then describe the methodological approach for testing our model, followed by presentation of the analysis. Subsequently, we build upon the results of our quantitative analysis using post hoc content analytic approach to explore whether and how IS work is used by scholars from other disciplines. Finally, we conclude with a discussion of the caveats regarding our findings and the broader implications of our work.

Literature Review and Model Development

Literature Review

Scholars have long underscored the importance of introspective study to evaluate if an academic field is moving in a desired direction. For example, during the embryonic stages of the field of Information Systems, Keen (1980) emphasized the importance of reference disciplines that can serve to inform the field. Early scholars in the field hoped that the continued discussion, application, and refinement of knowledge that would occur through repeatedly drawing from the same pools of knowledge would help the IS field to form its own knowledge underpinnings (Cole, 1983). This is what Keen called "developing a cumulative tradition," and it is considered necessary for a field's growth and development. IS scholars have since aggressively investigated these ideas through introspective studies in an effort to answer questions about the discipline's evolution and the building of a cumulative research tradition.

Introspective attempts to define the evolutionary developments in our field have been expressed in various ways in the literature. One approach is through the analysis of subject matter. In this line of inquiry, scholars have tried to understand if IS has been able to create a distinct subject matter of its own. For example, studies in this stream of thought include those that explore the thematic areas of IS articles to determine popular topics of research (Alavi and Carlson, 1992; Lee and Gosain, 1999); those that perform a thematic analysis of the research strategies of IS articles to determine whether a shift from non-empirical to empirical studies indicated progress (Farhoomand, 1987); and those that provide a synthesis of the core bodies of research and identify areas that are unique to our field (Davis, 1999).

Another approach in the IS-evolution literature does not directly pertain to the shift in subject matter or to the subject matter itself, but rather focuses on the composition of the field in terms of the patterns of knowledge drawn upon. Studies in this stream include those that have examined IS as a composition of different disciplines (Bariff and Ginzberg, 1980; Davis, 1980; Davis and Olson, 1985; Kendall and Kriebel, 1980) or those that have examined knowledge utilization among IS researchers (Hamilton and Ives, 1982). Drawing upon the rich intellectual contributions in the evolution of IS, Swanson (1984) argued that three fields (Computer Science, Management Science, and Organization Science) constitute the necessary foundations for IS. Culnan (1986) and Culnan and Swanson (1986) subsequently made attempts to understand if IS emerged as a distinct field of study by examining the intellectual subfields within the discipline.

Although insightful and intellectually stimulating, most of the work in this area found IS research to be fragmented (Banville and Landry, 1989) and *presumed or found a one-way relationship* between IS and its foundational reference disciplines. That is to say, IS

is viewed as relying on Management Science, Computer Science, and Organization Science to make sense of its subject matter. While the more recent replication study by Cheon et al. (1992) suggested that IS may have started to repay its debts by contributing back to its classical foundational disciplines, the received literature (earlier empirical and conceptual works, and the more recent deliberations on the state of the IS discipline) on progress of the IS discipline generally appears to view IS as a fragmented adhocracy and an importer of knowledge.⁵

The Culnan and Swanson Study

The Culnan and Swanson (1986) study investigated relationships between IS and its reference disciplines, and the extent to which a cumulative research tradition had been forged. They used definitions of *work points* and *reference points* to represent the structure and the nature of the field. The work point for an article refers to the field represented by the journal in which the article appears. Reference points for an article refer to the distribution of the article's bibliographical references to journals at the same and other work points.⁶ Therefore,

“the relative frequency, with which MIS articles are published at different work points, and the corresponding distributions of reference points for these same articles, provides a useful basis for the location of the MIS field (page 291).”

Culnan and Swanson (1986) posited that Computer Science, Management Science, and Organization Science carry the theories and the concepts that provide foundational value for the field of IS (see Figure 1). The results of their study generally supported the proposition that IS was evolving as a distinct mode of inquiry. Cheon et al. (1992) extended these ideas in terms of time period covered and the kind of journals selected. Unlike the original study, they found preliminary evidence that suggested that other fields have started to identify IS as a distinct work point.

New Reference Disciplines for IS

In this paper, we propose (and expect) that as a discipline, IS is drawing from new reference disciplines and possibly moving away from the conventional reference disciplines while building a tradition of its own. We also expect that IS has started to repay its debts by providing value-added contributions and informing work done in other disciplines. Since the last empirical assessment of the progress of IS by Cheon et al. (1992), there have been many manifestations of technological change. For example, we

⁵ Testimony to our observation that received literature has treated IS as a fragmented adhocracy and an importer of knowledge are early articles by Banville and Landry (1989), Culnan and Swanson (1986), and Keen (1980) to name a few. More recent contributions from those by Benbasat and Zmud (1999), DeSanctis (2003), Orlikowski and Iacono, (2001), Robey (2003), etc. have espoused the same position. Our observation that IS is treated as a fragmented importer of knowledge itself is not contested.

⁶ Consider an article published in *MISQ*, which has 10 references (five references are from articles published in IS journals; three are from articles published in Organization Science journals; and two are from articles published in Management Science journals). This particular article would represent an IS work point (because it is published in *MISQ*) and its reference points would be IS, Organization Science and Management Science (the distribution of the article's references).

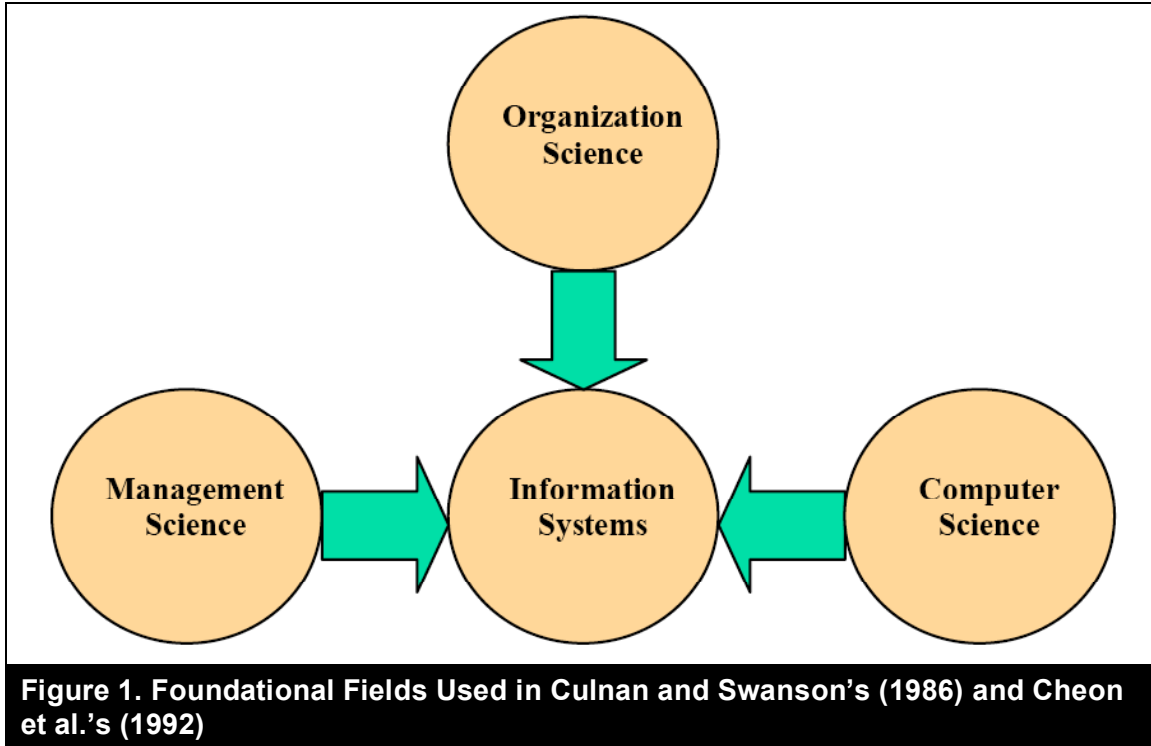


Figure 1. Foundational Fields Used in Culnan and Swanson's (1986) and Cheon et al.'s (1992)

have seen interest in the reengineering trend of the early 1990s, enterprise systems, changes in interfirm governance structures, the rise and fall of dot-coms, etc. Perhaps most significant is the evolution of the Internet and the emergence of e-business initiatives. These IT changes have created much of the stimulus to affect practices in other disciplines. Achrol and Kotler (1999), for instance, provide substantive evidence of how the discipline of Marketing has been widely impacted by arrival of networked markets; Mata et al. (1995) provide evidence of the impact of IT on the field of strategy; while Banker and Kauffman (2004) provide an insightful discussion on how IT has impacted practices such as job floor scheduling, supply chain reconfiguration, and decision modeling, to name a few.

Given the dynamism associated with issues of concern to the field, sources of theoretical inputs to IS research are also changing. Among the many changes that possibly inform IS work, two dominant ones (due to the proliferation of the knowledge economy) are, we believe, Marketing and Economics. To more formally examine our expectation that Marketing and Economics may serve as important sources of theoretical inputs, we randomly sampled 50 papers in the three premium journals (*ISR*, *JMIS*, and *MISQ*) over the period of interest in this study (1990-2003). Due to the changes brought about by the knowledge economy, we expected to see a rise in references pertaining to Marketing and Economics. While our random sampling showed that our expectations were by and large accurate, this is not surprising. For instance, in the case of Marketing, observations reveal the presence of E-Commerce and the proliferation of studies on "Network Markets" (for an excellent discussion see Achrol and Kotler (1999)). The ubiquity of the Internet and digital technology has created numerous opportunities in the field of IS. Testimony to this has been the recent surge in articles that have drawn from the theories of Marketing that deal with relationships between parties. For instance, concepts of service quality have been used to analyze the effectiveness of IS outsourcing

relationships (Grover et al., 1996); relational exchange theories are used to examine performance of IS contracts (Kim and Chung, 2003); theories of consumer behavior are used to study customer relationships and purchase behavior (Jarvenpaa et al., 2000; Koufaris, 2002). We argue that with the impact of digital technologies on the nature of products, services, pricing, and distribution, Marketing will be an increasingly important source of theoretical and methodological inputs for IS research.

We also observed the phenomena of “the productivity paradox” and the increasing infusion of Economics (see for instance Hitt and Brynjolfsson, 1996) in addressing both the paradox issue and issues in networked and E-Commerce markets (cf. Grover and Ramanlal, 1999). Furthermore, prior work suggests that Economics has been a key reference discipline for IS (Kriebel and Moore, 1980; Swanson and Ramiller, 1993). In the case of Economics, there has been much discussion of IT creating the stimulus for much of the recent economic growth cycles. The impacts of IT on business valuation and governance structures are becoming increasingly fertile areas for research. A growing number of studies has started to pay attention to the broad fusion of IT and Economics in general. For instance, econometrics has been used to examine the relationship between IT and productivity (Brynjolfsson and Yang, 1996). Some scholars have resorted to the use of economic theories like production models and duopoly competition models (Quan et al., 2003) for studying IT impacts; others have used transaction cost theory (Zaheer and Venkatraman, 1994) to study IT’s impact on interfirm relationships; game theoretic approaches have been applied for studying IT investments and outsourcing (Butterfield and Pendergraft, 2001; Elitzur and Wensley, 1997); and still others have used measures like multi-factor productivity (Hitt and Brynjolfsson, 1996) for evaluating IT. Furthermore, many premier institutions (UC Irvine, Carnegie Mellon, and MIT, to name a few) have projected the interplay of Economics and IT as one of the core areas of their faculty research.

Considering these developments, we believe that it is appropriate to explicitly consider Economics and Marketing as reference disciplines for IS in addition to the oft used classical disciplines. Admittedly, multiple other disciplines may serve as a source of important theoretical inputs. With respect to these changes (or sources of theoretical inputs), a case can therefore be made to identify all possible sources of inputs that are likely to inform IS work (i.e. all disciplines other than those considered in this research). For instance some scholars have argued that IS draws upon a repertoire of reference disciplines like Engineering, Architecture, and Sociology to name a few (Banville and Landry, 1989; Baskerville and Myers, 2002; Robey, 2003). Our own view is in agreement with this line of thought but with an important distinction. Specifically we maintain that in a “constellation of reference disciplines” with IS at the center, it is highly unlikely that each reference discipline plays an identical role in enriching IS work. It is far more likely that some disciplines take a disproportionate share as a source of inputs compared to other disciplines, and the extent of share taken in itself varies by changes in the environment (or, more formally, the issues addressed by IS work at any given point in time).⁷ In sum, while IS might be informed by numerous disciplines, for reasons and observations outlined earlier, we believe Marketing and Economics may play a central and disproportionate role in today’s knowledge economy.

⁷ Our argument has been more formally (and mathematically) examined in the work of Ludwig von Bertalanffy’s (2003) treatise of a “General Systems Theory” where he maintains that systems are never in equilibrium. Rather the norm is one of disequilibrium where different system components take disproportionate share of the work based on different exogenous conditions.

Finally, we note that the focus of this research is not only to examine sources of theoretical inputs (or the shifts) into IS research, but also to examine whether IS stands at the end of the intellectual food chain or at the center of a network of knowledge (from where other disciplines might possibly be enriched by IS work). The test of this multifaceted focus requires us to consider those changes that result from large scale changes in the environment. For instance, to address our first research question regarding how the IS field has evolved with respect to drawing upon reference disciplines, we needed to identify a set of disciplines that may play a disproportionate share in informing IS work. Not doing so (i.e. identifying all possible sets) implies either an understatement or an overstatement of the shift in reference disciplines.⁸ Concomitantly, to address our third and fourth research questions we needed to identify a set of disciplines that may also benefit from IS work. It is intuitive that a discipline that is unlikely to inform IS work (our first research question) is also unlikely to draw upon IS work, since the two can be considered mutually exclusive. For the aforesaid reasons, and to maintain a parsimonious and reasonable boundary condition for this study, we considered the two additional disciplines of Economics, and Marketing (where a possible didactic interplay may occur) in addition to the three classical disciplines suggested by Swanson (1984), and empirically tested in Culnan and Swanson (1986).

Model Development

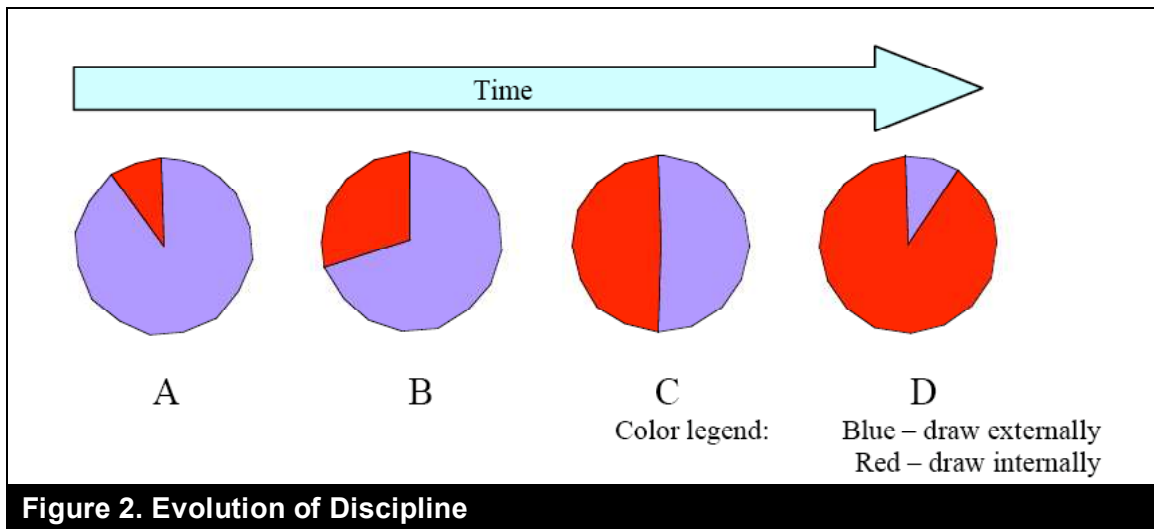
Disciplines build competent knowledge claims by relying on both intra-disciplinary as well as inter-disciplinary work. In general, as disciplines mature and start to form a distinct identity of their own, they not only depend less on other disciplines for supporting their work and building competent knowledge claims, but also tend to increasingly inform work in other fields. Miner (1984), in his critique of the organization sciences, argued that the stock of progress made by a discipline can be seen by how much it depends on its own sources and how much it contributes to other disciplines. Similarly, economist Joseph Schumpeter has stressed the notion that any field of inquiry that justifiably earns the distinction of being called a discipline should provide the world with theories and paradigms and draw more upon work within the discipline (Schumpeter and Opie, 1934).

While other theoretical perspectives might support our arguments, here we choose to focus on the systems theoretic perspective outlined by Miller (1978). The reason for doing so is twofold. First, the systems perspective developed by Miller, although set up

⁸ Consider a very simple event in which all disciplines are considered instead of a few dominant ones. Assume that there is a study prior to 1990 (e.g. Culnan and Swanson (1986) which we extend) which considers X reference disciplines instead of the total set of Y disciplines (where $Y > X$) which were referenced by IS work. Now considering that we wish to extend this earlier study we consider all Y reference disciplines. Arguably since each discipline is weighted equally (i.e. a discipline contributing a single reference is the same as another one contributing 50 references) we would conclude that large scale shifts have occurred in whom we draw upon since our Y is always bound to be $> X$. This is an overstatement since had we assumed that all Y disciplines contributed also to the earlier study then in reality no shift occurred at all. This is a case of a Type II error where we conclude that a shift occurred when theoretically there was none. An exactly opposite scenario can be formulated for the understatement case where a shift really occurred but cannot be detected causing a Type I error. Our argument is simple: If disciplines are not selected based on the extent of contribution they provide to IS work, theoretically no shifts can be detected. In fact, in the extreme case, no shifts can ever occur because to assume that Y reference disciplines provide inputs to IS research now implicitly entails assuming all Y also contributed in the earlier study.

within the bounds of biological sciences, is intended to be a general perspective that is independent of disciplinary idiosyncrasies. Thus, this theoretical perspective is widely applicable and adaptable to a generic class of problems. Second, our treatment of disciplinary evolution is set up well within the thinking that Miller's work endorses. For instance, we view IS as one "component" in a system that has other components like "Marketing" or "Management" with whom IS interacts. This is a context similar to which Miller's work or the broader generic systems perspective (see Bertalanffy, 2003) aspires. In Miller's theoretical work on biological systems, a system is composed of different components that serve to fulfill some function. Each system is represented by or belongs to a class. One system may rely on or contribute more or less to another system just based on the class to which it belongs. Further systems are progressive and dynamic in that they can move from one class to another. Thus, a system X at a lower level, which relies extensively on other systems Y for its operation, may move to a higher level by beginning to perform some of the functions once provided by Y.

At a generic level, Miller (1978) refers to the hierarchy of "totipotential," "partipotential," and "fully functional" systems to illustrate his thinking⁹. Fully functional systems are those that perform all assigned functions satisfactorily. Partipotential systems (a progressively higher order system), on the other hand, tend to specialize and gain expertise in certain functions but rely on other systems to fulfill those they cannot perform (draw upon other systems). At the same time, partipotential systems may (or may not) also contribute to other systems by providing some functions that other systems are not capable of performing. Highest in the hierarchy are totipotential systems that draw marginally upon other systems, but provide extensive contributions (draw less, contribute more). Figure 2 illustrated below is a simplified presentation of the aforementioned concepts:



The field of Economics is a classical exemplar of a totipotential system, where the tendency to cite intradisciplinary work is extremely high and the tendency to cite interdisciplinary work is extremely low. At the same time, as noted by Ferraro et al. (2005), Economics serves as a dominant source of theoretical inputs to many other disciplines in the social sciences. Systems, however, can also progress backward in that a system at a totipotential stage might return to the partipotential stage. Whether this

⁹ We are indebted to Detmar Straub for these concepts.

happens is related to the extent to which exogenous changes occur such that components in a system that were useful at one point in time may no longer prove useful, or functions provided by the system can be more efficiently fulfilled by relying on other components. Finally, note that exogenous changes may not necessarily trigger reliance on other components. The extent to which systems seek outside assistance is dependent on whether the exogenous change has caused a critical operation to collapse or affects a non-critical part of the system. In the former case, systems will interact, but in the latter, they may or may not.

Distinctness of Work Points

IS research could be published at various work points (e.g., Computer Science), but IS work must reflect some unique characteristic of that work point. Culnan and Swanson (1986) posited that each work point could be differentiated by the predominant reliance on references to its own work point. For instance, references to the Management Science literature or Computer Science literature are most likely to be found in Management Science and Computer Science publications, respectively. This hypothesis is fundamental to this work, and a rejection would imply that references in a work point do not reflect its foundation base. We include the original hypothesis, as is, from the earlier work of Culnan and Swanson.

Hypothesis 1: On average, the reference point for any work point (within the six disciplines considered) will lie nearer that work point than will the reference points associated with the other work points.

Changing Composition of the IS Field

Here we address the question of how the field evolved with respect to drawing upon other disciplines. In early stages of IS (Point B in Figure 2), Swanson (1984) and Culnan and Swanson (1986) suggested three foundational fields as informing work in our field. Management Science was characterized by a socio-technical persona, using technical methods to solve industrial and social problems (see Ackoff, 1967); Organization Science was characterized by a socio-centric persona, whereas Computer Science was techno-centric. Early definitions of IS established the field as having a focus on systems and technology (Culnan, 1986). Further efforts to establish the building blocks of the discipline (for instance, the Minnesota experiments of the 1980s, and the entire cognitive style stream of research done in this period) led to IS primarily drawing upon these three foundational fields. However, it seems that the socio-technical persona has been retained while issues associated with pure technical artifacts have been sorted out. The focus has switched from studying the IT artifact itself to studying how this artifact should be best deployed in a social context, leading some observers to advocate for a reversal of this trend (Orlikowski and Iacono, 2001). We therefore propose:

Hypothesis 2a: IS work is relying increasingly upon work in Management Science over time.

Hypothesis 2b: IS work is relying increasingly upon work in Organization Science over time.

Hypothesis 2c: IS work is relying less upon work in Computer Science over time.

As noted previously, a number of significant shifts in the environment have occurred over the past decade. Economics and Marketing have emerged as the key tools for addressing issues in the Information Economy. Noting that both fields have a rich intellectual and established heritage for effectively addressing problems in the information economy we suggest that:

Hypothesis 2d: IS work relies increasingly upon work in Economics over time.

Hypothesis 2e: IS work relies increasingly upon work in Marketing over time.

Cumulative Tradition

Prior research has suggested that intradisciplinary publication frequency is an indicator of interaction with prior research efforts (Hamilton and Ives, 1982). The evolution of IS can be traced by understanding if it is relying more on references from its own work point for supporting competent knowledge claims. To get a better understanding of the growth of the IS field, it is important to consider the evolution of the field over time. This hypothesis allows us to examine whether IS is indeed emerging as an established field of study (building of a cumulative research tradition).¹⁰ In other words, this hypothesis allows us to examine if we have progressed in terms of internal dependence on the timeline.¹¹

Hypothesis 3: IS draws more upon work published at an IS work point over time.

Knowledge Transfer between Disciplines

We suggest that as environments change, some reference disciplines gain prominence (as inputs to IS), and others are pushed back. Disciplines adapt and respond to these changes to reach this progress equilibrium, but the process is slow and often composed of a mix of “parental role” (others being dependent on our discipline), and a “child role” (our discipline seen as depending on some others).

Reference disciplines can be segregated as either classical reference disciplines (those that we have traditionally drawn upon) or contemporary (new reference disciplines like Economics and Marketing). IS and these foundational fields have experienced a vibrant and rich interaction, with the classical disciplines so far playing a parental role for IS (Cheon et al., 1992, Culnan and Swanson, 1986). However, as the IT component has pervaded organizations and caused an environmental shift, we see signs of IS playing a dominant “parental role” and informing work in these classical areas that have been hitherto unaffected by information technology. This is akin to evolving toward the totipotential stage in systems. We therefore formally propose:

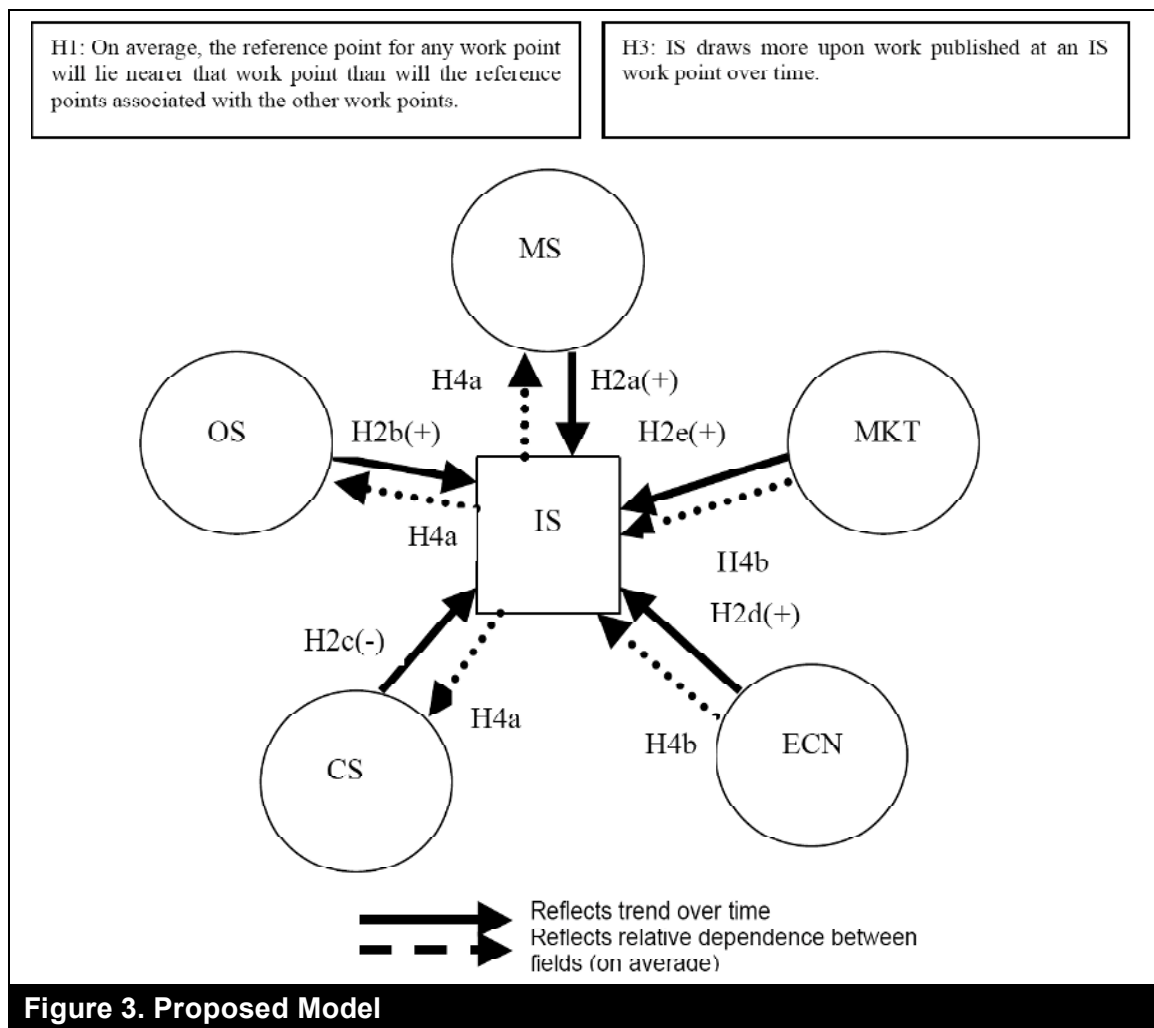
Hypothesis 4a: On average, the dependence of IS on classical reference disciplines is less than the dependence of classical reference disciplines on IS.

¹⁰ Peter Keen defines a cumulative research tradition as one where we build on each others (intra-disciplinary) and our own work (Keen, 1980).

¹¹ It should be noted that high levels of fragmentation of the IS field (as some observers maintain) will dampen the quest for cumulative tradition.

The advent of IT networks is having a significant impact on both the Economics of “rent appropriation” in the market, and the means to “appropriate rents” in a competitive arena. Firms have increasingly started to rely on establishing “unique resources” like relationships with customers to compete in a new digital economy. These shifts reflect significant environmental changes and we would argue that “emerging disciplines”¹² like Economics and Marketing have the potential of taking the new “parental role.” We suggest that before IS can adapt to these changes and form a cumulative body of knowledge as a response to this shift it will subjugate itself to the child role. Once learning occurs by drawing upon work in emerging but established disciplines in the child role, IS should start moving over the longer time cycle from a partipotential to a totipotential system. We formally propose:

Hypothesis 4b: On average, dependence of IS on emerging reference disciplines is more than the dependence of emerging disciplines on IS.



¹² The term “emerging” in this context implies that disciplines like Economics are emerging as reference disciplines for IS, even though Economics itself is an established discipline.

Methodology

The accuracy and reliability of our study hinges largely on the type of journals selected to represent the work points. Furthermore, it is important to carefully identify the IS articles within the selected publications at non-IS work points.

Journal Selection

We carefully selected journals for each of six work points to fairly represent each work point. To establish an objective criterion for journal selection, in Table 1 we compare the journal selections of previous studies that had faced a similar issue with those selected for this study. In addition, we consider the ranks of journals at the respective work points. Ideally, reputable journals that clearly lie at the work point being considered, and are receptive to IS work, should be selected.

MIS Quarterly (MISQ) has been used in all previous studies and is selected for our study. The other two journals selected are *Journal of Management Information Systems* (JMIS) and *Information Systems Research* (ISR). These three journals have been consistently ranked as top journals in the IS discipline (Hardgrave and Walstrom, 1997; Mylonopoulos and Theoharakis, 2001; Walstrom et al., 1995; Whitman and Hendrickson, 1999). A recent global survey conducted by Lowry et al. (2004) confirms that the three selected journals are perceived as the top three IS journals worldwide in terms of both richness (rigor) and reach.

For the Management Science (MS) work point, *Management Science* and *Decision Sciences* were most commonly used by previous studies. We selected these two journals for our study since they are widely accepted as premier outlets for publishing quality research (Holsapple et al., 1993).

At the Computer Science (CS) work point, pure technology-oriented journals are not considered since these journals are not receptive to IS research. CACM, although popular in prior studies for the CS work point, is not considered in this study because of its recently adopted practitioner orientation. Moreover, it limits the number of allowable references to twelve. Lowry et al. (2004) identified the ACM Transactions series of journals as among the top Computer Science journals for IS researchers. We selected *ACM Transactions on Information Systems* (TOIS) and *ACM Transactions on Database Systems* for this study.¹³ In addition, we selected *Computing Surveys* based on its prior selection and its reputation as one of the top journals in the Computer Science field (Peppers and Ya, 2003). However, we eventually dropped *ACM Transactions on Database Systems* from the list because we did not find any articles matching the definition of IS in the journal (Lee, 1999).

Academy of Management Journal, *Academy of Management Review*, and *Organization Science* are regarded as prestigious (Lowry et al., 2004), and have been used in previous studies to represent the Organizational Science (OS) work point. We did not

¹³ Since Computer Science is a very fragmented field, there are many premier journals for us to consider. Though other journals might be relevant, we defend our choices as reasonable, if not optimal.

Table 1. Selected Journals at Different Work Points			
WORK POINTS	JOURNALS SELECTED IN CURRENT STUDY	JOURNALS SELECTED IN PRIOR STUDIES	RATIONALE FOR SELECTION
IS	<i>MISQ, JMIS, ISR</i>	<i>MISQ, I&M, DB, DAMA, JSM, EDPA, ICIS</i>	MISQ, JMIS, ISR consistently ranked in top 3 journals ¹⁴ . Global survey by Lowry et al. (2004) ranks these as top 3.
MS	<i>MS, DS</i>	<i>MS, DS, INT</i>	MS and DS regarded as premium outlets (Cheon et al., 1992, Holsapple et al., 1993).
OS	<i>AMJ, AMR, OS</i>	<i>AMR, AMJ, ASQ, HBR, SMR, BH</i>	AMJ, AMR, and OS cited as the premium journals.
CS	<i>COSU, TOIS</i>	<i>CACM, COSU, TODS, IBMSJ</i>	COSU and TOIS are premium journals. TOIS additionally reflects a business journal at CS work point as opposed to a purely technical one.
ECN	<i>AER, ECMT, JPE</i>	None	AER, ECMT, JPE are premium journals in Economics (Kalaitzidakis et al., 2003). These are also the most frequently mentioned journals (Pieters and Baumgartner, 2002). Pilot study for 2 years confirmed that these 3 are used at the IS work point.
MKT	<i>JM, JMR, JCR</i>	None	Premium journals in Marketing (Hult et al., 1997). Pilot study for 2 yrs confirmed that these journals are most frequently used in IS work point.
<i>ACMIS: ACM transactions on Information systems AER: American Economic Review AMJ: Academy of Management Journal AMR: Academy of Management Review ASQ: Administrative Science Quarterly CACM: Communications of the ACM COSU: ACM Computing Surveys DAMA: Datamation DB: Data Base DS: Decision Sciences ECMT: Econometrica EDPA: EDP Analyzer HBR: Harvard Business Review IBMSJ: IBM Systems Journal ICIS: Proceedings of the ICIS</i>			<i>INT: Interfaces ISR: Information Systems Research I&M: Information and Management JCR: Journal of Consumer Research JM: Journal of Marketing JMIS: Journal of Management Information Systems JMR: Journal of Marketing Research JPE: Journal of Political Economy JSM: Journal of System Management MISQ: MIS Quarterly MS: Management Science OS: Organization Science SMR: Sloan Management Review TODS: ACM transactions on Database systems TOIS: ACM transactions on Information systems</i>

¹⁴ See for instance the studies by Cheon et al. (1992), Hardgrave and Walstrom (1997), Mylonopoulos and Theoharakis (2001), Walstrom et al. (1995), and Whitman and Hendrickson (1999).

include practitioner journals such as *Harvard Business Review* and *Sloan Management Review*.

The Journal of Marketing, *Journal of Consumer Research*, and *Journal of Marketing Research* are considered premium journals in the field of Marketing (MKT), and have consistently been ranked among the top five journals (Hult et al., 1997). Thus, these three journals are included in this study.

We selected *American Economic Review*, *Econometrica*, and *Journal of Political Economy* as journals representative of the Economics (ECN) work point. These are consistently ranked among the top five Economics journals (Kalaitzidakis et al., 2003), and are the most frequently mentioned Economics journals (Pieters and Baumgartner, 2002).

To check for appropriateness of journal selection, we randomly selected 50 articles at the IS work point. Assessment of citations of these articles revealed incidences of all the non-IS work point journals, indicating that the journal selection at non-IS work points was indeed appropriate. All journals considered by this study reflect quality research, and we believe they indicate a wide range of areas from which IS research is both drawing and contributing.¹⁵ By selecting widely regarded premium journals at the various work points we exhibit some degree of control over author preference bias.

Defining IS Research

To select IS articles at non-IS work points, it is important to consistently frame what IS work implies. Prior work has consistently emphasized the socio-technical nature of IS. For instance, Mason and Mitroff (1973) provided one of the early comprehensive frameworks for IS research. They defined the field of information systems as consisting of "...at least one person of a certain psychological type who faces a problem within an organization context for which he needs evidence to arrive at a solution (i.e., to select some course of action) and that the evidence is made available to him through some mode of presentation." Similarly, Jenkins and Johnson (1977) enhanced the Chervany and Dickson (1974) work to provide a research framework that is similar to, but more contemporary and streamlined than that of Mason and Mitroff (1973). Jenkins' research framework is based upon the following definition of a management information system: "An MIS is at least one person utilizing an information system to undertake a task and the resulting performance." Finally, Davis (1974) provided a generally accepted and representative but early definition of IS: "MIS is an integrated, man/machine system for providing information to support the operation, management, and decision making functions in an organization."

A common theme that runs across these various views is the consideration of IS as a technology in interaction with society. This view was more recently endorsed by Lee (1999), where he rejects the general notion of treating IS as a dichotomous body of technological or social systems, and encourages IS scholars to examine the rich

¹⁵ As such, we argue that the work in these journals is representative of the *best work in each field* and so the question can be interpreted as whether the best work IS is influencing or being influenced by the best work in other fields. Since we use proportion of references and do consider all journals at a work point collectively, sensitivity to journal selection becomes less of an issue.

interactions between the technical and the social aspects of information systems. The *Association for Information Systems* complements this by defining IS as “producing the artifacts for use of individuals, organizations, and society.”¹⁶

We used these definitions to form the frame of reference for defining and identifying IS research. Although these “generally accepted” definitions in no way preclude inclusion of other defining elements of IS research (e.g. research on databases and technical IS work), by adopting the mainstream definitions, we hoped to position our work such that it might be of interest to the overall IS community.¹⁷

Article Selection at Non-IS Work Points

This study included IS articles at the six work points from 1990-2003. All the articles from the three journals at IS work points were considered for analysis in this study. For non-IS work points, IS articles were selected for inclusion based upon the definitions provided earlier.¹⁸ Specifically, selection entailed (a) reading the title and abstract for each article, (b) examining the keywords of the article with respect to the keyword index, and (c) using the definitions of IS as proposed by Lee (1999) and AIS. For each article, three authors performed this evaluation independently, and made a dichotomous determination (Yes or No) about whether it could be regarded as an IS piece. If at least two out of three agreed, the article was classified as IS. If only one author felt it should be included, the whole text of the article was read and discussed in detail before making a final determination. The average kappa¹⁹ value was found to be 0.7591 prior to discussion among authors, while the post discussion average kappa value was found to be 0.8597, indicating substantial agreement among the three researchers.

Analysis

The distribution of the *mean proportion* of references to total references²⁰ for the six work points is shown in Table 2. The data presented in Table 2 is used for testing Hypothesis 1, which posits that each discipline relies more on its own discipline for reference than on other disciplines. Univariate analysis of variance (ANOVA) was used to compare the mean proportion of references to total references among the work points.

¹⁶ <http://www.aisnet.org/adm/policy.shtml>

¹⁷ We are sensitive to the fact that our mainstream definitions of IS may not be endorsed by everyone. These views might preclude us from selecting articles (e.g., Latent semantic models for collaborative filtering, Burst ties: a fast efficient structure for string keys) that we view as too technical. However, we believe that these definitions represent the views of the majority, and offer a reasonable basis for the conduct of this study.

¹⁸ The number of selected articles for each journal differs among the journals, which might cause an imbalance in the weight of journals. However, there is no reason to believe that any one particular journal has an affiliation with other disciplines. Therefore, a journal set of each discipline will collectively represent the corresponding work point.

¹⁹ Prior research notes that the kappa value computed by averaging the individual kappas between pairs of authors is a more robust measure of the inter-rater reliability. In this research the authors coded their selections as (dichotomous) Yes-No and averaged the individual kappa to get as close to the true value as possible.

²⁰ For each selected article, the total number of references and the references to each work point are counted manually. By using proportions, the relative importance of inputs over time can be accurately assessed.

Because assumptions of normality and homogeneity of variance are both violated, ranked scores obtained from raw data were used for ANOVA procedures.

An initial look at the higher diagonal numbers seems to support the hypothesis. Without exception, the mean proportion of references to the total references of a work point is higher at the same work point as compared to other work points. To statistically demonstrate the differences, we conducted post hoc tests. The results indicate significant differences among work points. For example, the mean proportion of IS references across work points is different, and it is the highest at the IS work point (see note (a) in Table 2). The results indicate that Hypothesis 1 is supported. This also supports a basic assumption of this paper, that work points reflect their foundational base. Therefore, the selected work points appear to be well represented with robust distinction between work points.

Table 2. Work Points and Associated Reference Points							
Reference Points Work Points	Mean proportion of References to Total references						Number of total references ²¹
	IS	MS	OS	CS	ECN	MKT	
IS	11.53	4.24	3.22	0.59	0.75	1.04	54,700
MS	10.45	9.57	3.01	0.40	2.34	1.70	11,098
OS	5.70	3.48	8.24	0.35	0.82	0.70	3,918
CS	3.99	2.10	2.78	1.58	0.34	0.00	1,563
ECN	0.00	0.60	0.00	0.00	12.88	0.00	357
MKT	0.89	2.76	1.29	0.12	1.35	22.89	865
ANOVA F (df=5,1401) p-value	23.278 (a) 0.000	31.177 (b) 0.000	15.995 (c) 0.000	6.064 (d) 0.000	13.888 (e) 0.000	23.763 (f) 0.000	
<p>Note: Post-hoc tests for significant differences (at $p < 0.05$) between work points (LSD method)</p> <p>(a) IS differs from MS, OS, CS, ECN, and MKT in terms of IS references.* (b) MS differs from IS, OS, CS, ECN, and MKT in terms of MS references. (c) OS differs from IS, MS, CS, ECN, and MKT in terms of OS references. (d) CS differs from IS, MS, OS, ECN, and MKT in terms of CS references. (e) ECN differs from IS, MS, OS, CS, and MKT in terms of ECN references. (f) MKT differs from IS, MS, OS, CS, and ECN in terms of MKT references.</p> <p>* The mean differences in IS and MS work points are significant at 0.074 level.</p>							

Hypothesis 2 examines the changing composition of reference disciplines for the IS field over a fourteen-year period. Table 3 shows the mean proportions of non-IS references to total references at the IS work point. For example, Management Science constitutes, on average, 4.76 percent of 5,089 references in IS journals in 2003.

²¹ We are using the proportion of references to total references, not absolute counts. So, inclusion of another journal won't affect the results unless the additionally included journal has a particular association with specific disciplines.

Hypothesis 2a suggests that over time, the relevance of Management Science as a reference discipline is increasing. We analyzed the trend of MS references at the IS work point over the last 14 years to test this hypothesis. The results show a negative slope coefficient with no significant trend ($B=-.004$, $p\text{-value}=.938$). Thus, Hypothesis 2a is not supported. This indicates that MS has kept its weight as a reference discipline for IS over time.

Year	MS	OS	CS	ECN	MKT	Total number of References
1990	3.71	1.98	0.67	0.71	0.3	2,672
1991	3.62	2.40	0.83	0.58	0.71	3,119
1992	5.85	2.40	0.93	0.49	0.72	3,452
1993	4.33	2.40	0.56	0.26	0.46	3,048
1994	3.52	2.93	0.42	0.22	0.83	3,613
1995	5.42	3.55	0.69	0.44	0.93	3,637
1996	3.99	3.51	0.59	0.59	1.04	4,413
1997	4.35	3.85	0.47	0.78	1.59	3,584
1998	3.57	4.28	0.61	0.54	0.93	4,090
1999	3.96	4.49	0.51	0.17	1.16	4,146
2000	4.12	2.86	0.43	0.92	0.92	4,683
2001	3.73	6.01	0.40	0.56	1.63	4,473
2002	4.36	4.14	0.49	0.36	2.24	4,681
2003	4.76	6.66	0.20	0.98	2.08	5,089

Hypothesis 2b proposes that the relevance of Organization Science as a reference discipline is increasing. We analyzed the trend of OS references at the IS work point over the last 14 years to test this hypothesis. The results show a positive slope coefficient with significance at the .01 significance level ($B=.277$, $p\text{-value}=.000$). Thus, Hypothesis 2b is supported. This indicates that OS has increased its weight as a reference discipline for IS over time.

Hypothesis 2c proposes a decline in the relevance of Computer Science as a reference discipline. We analyzed the trend of CS references at the IS work point over the last 14 years. The results show a negative slope coefficient that is significant at .01 significance level ($B=-.034$, $p\text{-value}=.001$). Thus, Hypothesis 2c is supported. The results support the contention that the IS field is less oriented toward solving problems of technology *per se*, but increasingly draws upon research on strategy, management, and organizations to study IS in its embedded social context.

Hypothesis 2d and 2e pertain to emerging reference disciplines and their inputs into the IS research. Hypothesis 2d posits an increasing trend in the Economics references at the IS work point. The coefficient for slope is positive, but not significant, indicating that IS has not *significantly* increased its reliance on Economics over time ($B=.145$, $p\text{-value}=.398$). Thus, Hypothesis 2d is not supported.

Hypothesis 2e posits that the relevance of Marketing as a reference discipline is growing over time. Examining the trend of the mean proportion of Marketing references at the IS work point yields a significantly positive coefficient for the slope at 0.01 level ($B=.118$, $p\text{-value}=.000$), thereby supporting H2e. Table 4 illustrates these results.

Table 4. Results of non-IS Reference Trend at IS Work Point					
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	4.264	.410		10.396	.000
DV: MS Ref. IV: YEAR	-.004	.048	-.023	-.080	.938
(Constant)	1.598	.437		3.656	.003
DV: OS Ref. IV: YEAR	.277	.051	.841	5.393	.000
(Constant)	.812	.071		11.508	.000
DV: CS Ref. IV: YEAR	-.0340	.008	-.764	-4.097	.001
(Constant)	.434	.141		3.091	.009
DV:ECN Ref. IV: YEAR	.0145	.017	.245	.876	.398
(Constant)	.227	.174		1.303	.217
DV: MKT Ref. IV: YEAR	.118	.020	.857	5.759	.000

Hypothesis 3 examines the evolution of the IS discipline over time by looking at the change in the mean proportion of IS references at IS work point. Table 5 presents the data to test the hypothesis over the 1990–2003 period. While the absolute number of references might be upwardly biased over time, due to the increasing base of historical IS references that can be drawn upon, proportions reflect relative inputs. Regression analysis clearly indicates a positive slope significant at $p<0.05$ level, as shown in Table 6. While there were indications of this in the earlier Cheon et al. (1992) study, the trend here seems to be far more definitive. These results suggest that the field is increasingly depending on its own knowledgebase as it strengthens its cumulative tradition.

Table 5. Average Proportion of IS References to Total References at IS Work Point			
Year	Number of IS references	Proportion	Number of Total references
1990	269.00	10.07	2672
1991	255.00	8.18	3119
1992	414.00	11.99	3452
1993	301.00	9.88	3048
1994	335.00	9.27	3613
1995	391.00	10.75	3637
1996	482.00	10.92	4413
1997	364.00	10.16	3584
1998	413.00	10.10	4090
1999	453.00	10.93	4146
2000	666.00	14.22	4683
2001	521.00	11.65	4473
2002	713.00	15.23	4681
2003	798.00	15.68	5089

Table 6. Regression Coefficients for Average proportion of IS References to Total References at IS Work Point

Model	Unstandardized Coefficients		Standardized Coefficients	t-stat	Sig.
	B	Std. Error	Beta		
(Constant)	8.336	.854		9.763	.000
DV: IS Ref. IV: YEAR	.403	.100	.757	4.019	.002

Using the 14 year average, Hypothesis 4 primarily tests whether the IS work point is “more” established as a separate discipline than its referent work point disciplines. We use the data in bold presented in Table 2 to test Hypothesis 4. This tests the relationships between the mean proportion of ‘x references’ to total references at the ‘y work point’ and the mean proportion of ‘y references’ to the total references at the ‘x work point’. For example, 4.24 is the mean proportion of MS references to total references at the IS work point, and 10.45 is the mean proportion of IS references to total references at the MS work point. To test Hypothesis 4, a two-sample t-test compared the mean proportions of each non-IS reference at the IS work point with the mean proportions of IS references at each non-IS work point.

From the results of the t-test in Table 7, there are significant differences between the mean proportion of IS references at MS, OS, and CS work points and the mean proportion of MS, OS, and CS references at the IS work point, respectively. For all the three differences, the IS reference proportions at non-IS work points were greater. Therefore, Hypothesis 4a is supported.²²

Table 7. Cross-Disciplinary Patterns of Mean proportion of References

Work Point	Non-IS references at IS work point	IS references at Non-IS work point	t-stat	p-value
MS	4.24	10.45	9.033	0.000
OS	3.22	5.70	3.238	0.002
CS	0.59	3.99	3.229	0.003
ECN	0.75	0.00	-9.635	0.000
MKT	1.04	0.89	-0.231	0.818

There are significant differences between the mean proportion of IS references at the Economics work point and the mean proportion of Economics references at the IS work point. As posited, there is only a one-way relationship where IS is drawing from the Economics work point. The result for the Marketing work point yields no significant differences. This implies that on average, Marketing is drawing from IS as much as IS is drawing from Marketing. Therefore, Hypothesis 4b is partially supported. These results are different from the results of Cheon et al. (1992) and Culnan and Swanson (1986), and provide the first evidence that IS is being recognized as a repository of quality work that other disciplines can draw upon. The results of these hypotheses are shown in Figure 4.

²² This result might seem to contradict the results from H2b. However, H4 examines mean differences on 14 year averages whereas H2 examines the 14 year trend.

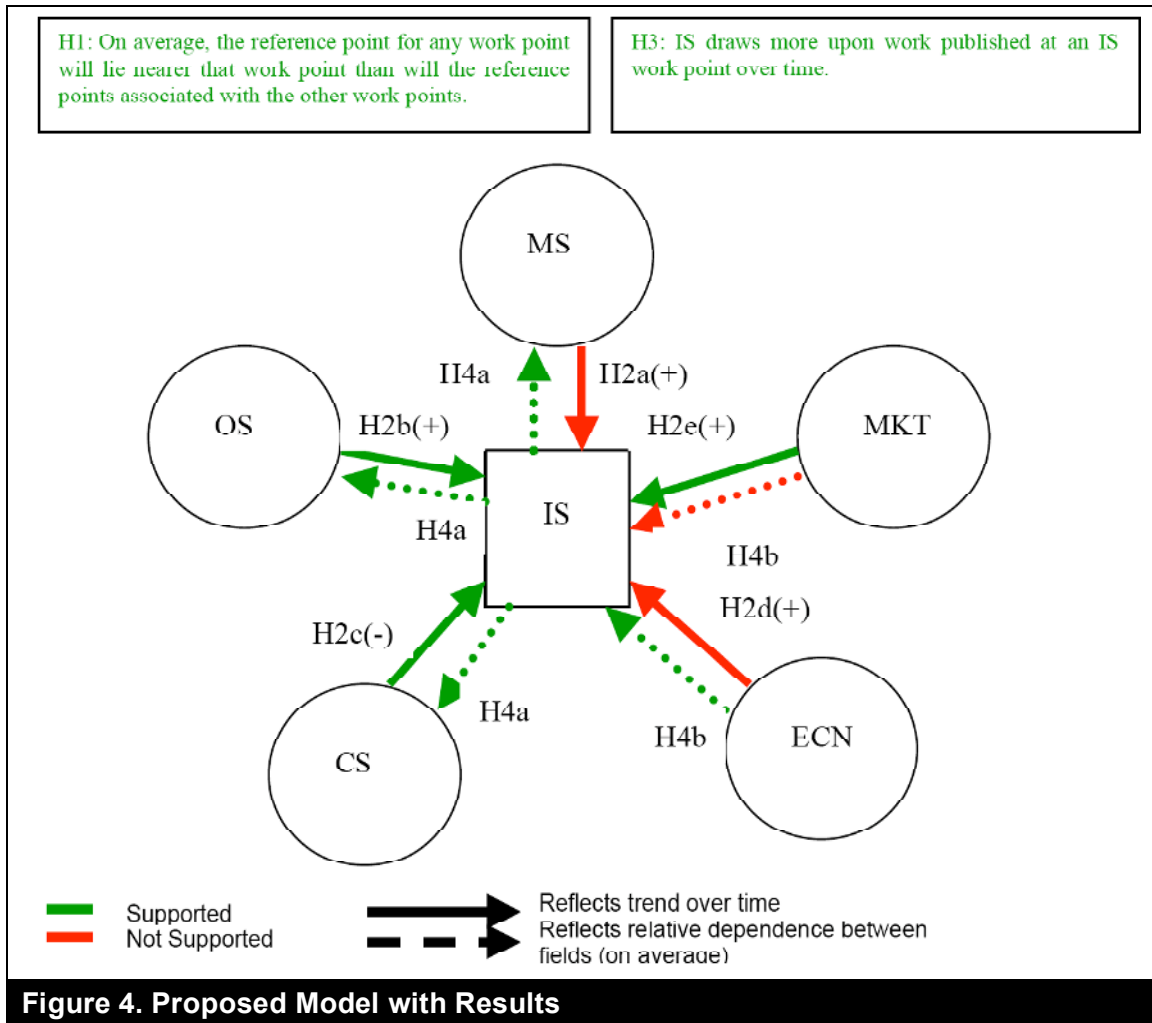


Figure 4. Proposed Model with Results

Discussion

There has been much debate about reference disciplines and cumulative tradition in IS conferences, colloquia, and other forums (Keen, 1980). Often the debate centers on the choice of reference disciplines and the importance of establishing a cumulative tradition.

We suspect that this is partially due to the fact that many IS scholars were originally trained in “other” fields, and importing from these fields was a natural occurrence. In later years, when the definitional identity of the field was established (i.e., through AIS), researchers brought ideas in from other disciplines and either used them in an IS context or modified them to better suit the IS context. In the former case, one could question whether the intellectual content belonged to the reference discipline (i.e., was the IS research simply an extension or application area for core ideas from the reference discipline). In the latter case, attempts were made to forge a distinct intellectual identity for IS by modifying and adapting theories appropriately. Regardless, IS has always been viewed as an importer of ideas. This study serves as a checkpoint for the state of the field with respect to these questions of reference disciplines and cumulative tradition. In examining the evolution of IS, we modeled the study on prior work done during the

formative years of the field. Although the choice of reference disciplines was modeled on these earlier studies, we do not see these choices as being as important as the observations that the field has singularly made progress across all dimensions. The consistency and the significance of our model results permit us to draw conclusions concerning the evolution of the field as a distinct mode of inquiry.

The Work Points are Distinct

Our analysis supports the contention that the proportion of references at any work point is greatest at that particular work point (Hypothesis 1). The unequivocal support for Hypothesis 1 indicates that the premise of the study is sound and the work points selected for this study are distinct.

Mix of Reference Disciplines Is Changing

Our results for the second hypothesis suggest that the mix of reference disciplines for IS is changing. Specifically, IS is relying less on traditional disciplines like Computer Science and more on emerging disciplines like Marketing and Economics. This suggests the increasing importance of IS in facilitating relationships and corporate value, and perhaps a reluctance to open up the IT "black box." The trend for IS to reference emerging disciplines is stronger in Marketing and weaker in Economics, but we suspect that the trend in Economics might be understated. Many IS scholars might not draw directly from journals in Economics, but instead draw upon books (e.g., Williamson's work on Transaction Cost Economics) or articles that use economic thinking to interpret an IS-related context (e.g., Malone et al's work on IT's impact on governance structures, first published in CACM).

IS Scholars Draw Primarily from Work Internal to the Field and Contribute to Other Fields

Our third hypothesis shows that IS is relying more on IS references, and the trend is distinctly positive. Such an unequivocal trend of an increasing cumulative tradition bodes well for a field that is still young, and we find this result particularly inspiring. Given the dynamic nature of the underlying IT catalyst, the field can be viewed as fragmented, which inhibits a cumulative tradition with the field as the unit of analysis. However, these results suggest that there is enough value being generated within the discipline to form the foundation for future work and also implies that the field is building on its knowledge.

The fourth hypothesis is arguably the most promising. We empirically observe that, with respect to the classical reference disciplines, IS is repaying its debt while continuing to draw from newer ones. However, here too the repayment cycle might be accelerating, as IS seems to be contributing commensurately to the Marketing literature base.

Conclusion from Analysis: IS Work Point Is Gaining Identity

We see the field moving strongly toward a distinct identity. The existence of an umbrella organization in AIS, consistency in the rankings of top journals, significant numbers of distinct IS departments, and increasing representation of senior IS faculty on tenure and promotion committees all reflect trends that complement the analysis presented here

regarding the maturity of the field. We also argue that the finding of a “cumulative tradition” bodes well as a necessary (but not sufficient) condition for reinforcing the core identity of the field. The contribution back to reference disciplines increases our recognition as the intellectual engine for IS research.

If indeed the conclusion of IS as its own intellectual engine is sound, then this begs two questions: (a) What is the core content of this engine? and (b) What is it contributing to the reference disciplines? Below, we offer some complementary qualitative analysis to gain richer insight into the omnipresent question of the field’s core and its emerging role as a knowledge source.

Qualitative Analysis: IS as Its Own Intellectual Engine

The Core of Our Field

We have noted that the sources that our field draws from are changing. From a techno-centric focus, with CS as a major reference discipline, the field is taking a more balanced socio-technical focus. As we distance ourselves from some reference disciplines and draw more from others (e.g., Marketing, Economics), it is important that the distinct fabric of our field be retained. Recent debates on the “core” of the field and the technological artifact are well placed, as we seek to be a driver of IS knowledge. To do so, we can continue to draw from other disciplines, but not simply to use IS as a test bed for their theories. Indigent theoretical development and a cumulative tradition can generate an intellectual engine that is the only source of inputs to disciplines on the effective construction and deployment of IS in a social (individual, group, organizational, interorganizational) context. While some might disagree that IS needs to be in the quest for elusive theory (Lyytinen and King, 2004), most will agree that the field must have boundary conditions that distinguish its intellectual pursuits from those of other fields.

Post-Hoc Content Analysis: IS Research Contributes to Other Disciplines

As Joseph Schumpeter stressed, any field of inquiry that earns the distinction of being called a discipline should contribute its knowledge to other areas of inquiry (Schumpeter and Opie, 1934).

The results of Hypothesis 4 suggest that over a 14-year period, the mean proportion of IS references to MS, OS, and CS work points is greater than the mean proportion of MS, OS, and CS references at IS work point. Also, Marketing seems to draw as much from IS as IS draws upon Marketing; perhaps researchers in Marketing are realizing the increasing importance of studying Marketing problems in an Information context, or Marketing is ‘poaching’ on natural IS topics.²³ In general, these results support the contention that IS is becoming an exporter of ideas.

However, which fields draw upon IS research? To address this question we performed a “cited reference search” for the period 1999-2003 using the same journals (*MISQ*, *JMIS*, and *ISR*) at the IS work point. we used Thomson ISI’s Web of Science to perform the search selecting three citation databases 1) SSCI Expanded 1985-2004, 2) SSCI 1985-

²³ We thank an anonymous reviewer for this argument.

2004, and 3) Arts & Humanities Citation Index 1985-2004. Following this, we examined which articles referred to articles from *MISQ*, *JMIS*, and *ISR*. The citing articles were then divided into categories as shown in Table 8 based upon which journal they were published in. For instance, if an *MISQ* article 'A' was referred to by another article 'B', and if article 'B' was published in a Management Science publication, then we counted "one hit" for the MS work point. By classifying all the articles in *MISQ*, *JMIS*, and *ISR* and repeating the procedure every time, we were able to identify a total of 23 distinct disciplines that draw from IS research.

Table 8. Summary of Disciplines Referring to Primary IS Publications							
DISCIPLINE	1999	2000	2001	2002	2003	Total Referring Articles	Proportion
Accounting		1		1		2	0.27%
Agriculture		1	1	4		6	0.81%
Art/Crafts				1		1	0.14%
Artificial Intelligence			1	3	13	17	2.30%
Behavioral Science		1	4	16	14	35	4.73%
Chemistry					2	2	0.27%
Communications		1	2	2	2	7	0.95%
Computer Science	1	4	17	41	68	131	17.70%
E-Commerce	1	4	13	19	37	74	10.00%
Economics		1	2	1	8	12	1.62%
Education		1	1	2	12	16	2.16%
Engineering			4	11	44	59	7.97%
Environmental Science			1			1	0.14%
Ergonomics	1	6	8	9	37	61	8.24%
Law			1			1	0.14%
Library/Information Science		1		4	10	15	2.03%
Management Science		9	16	26	83	134	18.11%
Marketing			1	15	25	41	5.54%
Mathematics					1	1	0.14%
Medical Science		1	1	7	17	26	3.51%
Organizational Science		9	14	19	34	76	10.27%
Physics				3	1	4	0.54%
Political Science			1	3	14	18	2.43%

Our analysis suggests that our traditional reference disciplines are increasingly drawing (CS: 17.70%, MS: 18.11%, OS: 10.27%) from IS; in a sense the tables have turned. It is also evident that fields like engineering (7.9%) and ergonomics (8.24%) are also benefactors of our knowledge base.

Therefore, despite the diversity of the field, there seems to be an intellectual engine emerging that can contribute to more “mature” disciplines. We believe that the results of the present study provide room for optimism as we look forward. However, it is crucial that we proactively leverage this momentum by building communication channels with other disciplines. By doing so, we can truly be part of an intellectual network and establish centrality in areas that matter to us most.

However, what does a particular article in OS that cites articles from *MISQ*, *JMIS*, and *ISR* actually say about IS? To address this question, we did a qualitative analysis on the articles published at non-IS work points and *how* they used the work from IS. To do this, we documented samples of articles at the OS, MS and CS work points, noted the major IS references (i.e., to *MISQ*, *ISR*, and *JMIS* only) in these articles and further analyzed how the IS references contributed to the work addressed in the article. Appendix I lists the titles of citing articles, summary of citing articles, cited IS references, and our assessment of how IS work is used at the OS, MS, and CS work points.²⁴

Overall, results from this analysis suggest that the IS work is used mainly to motivate other studies, to frame the problem statements, and to develop theoretical arguments. For the sake of parsimony, we summarize the contributions below and relegate most of the details to the Appendix. The intent here is not to be comprehensive in the analysis of how IS contributes to other work points, but to provide illustrations that can complement the findings from our quantitative data.

IS' contribution to Organization Science. The OS work point mainly emphasizes organizational forms, strategy, and competition. An increasing emphasis of IS scholars to solve organizational problems has led to the Organization Science field to being one of the main consumers of IS work. OS draws from a wide variety of IS research streams. Based on the sample of articles analyzed, these areas are found to be research on alignment between IT and strategy and structure (as used by Sabherwal and Chan (2001)), technology supported distributed teams (as used by Maznevski and Chudoba (2000)), the alignment of the IS function from a context/design fit perspective (as used by Brown and Magill (1998)), IT value and IT competitive advantage (as used by Duliba et al. (2001)), and IT-enabled organizational forms (as used by Nault (1997)). For a detailed analysis of these papers and how they used IS work, please refer to Appendix I.

IS' contribution to Management Science. The MS work point focuses on improving operations and implementation of systems. It draws from a wide range of IS research areas. Based on the sample of articles analyzed, these areas are found to be research on end user involvement, IS – business alignment (as used by Rondeau et al. (2002)), interorganizational/network relationships (as used by Guimaraes et al. (2002)), data quality or appropriateness of data (as used by Ballou et al. (1998)), business process change using a socio-technical perspective (as used by Frohlich and Dixon (1999)), and electronic integration/network relationships (as used by Mukhopadhyay and Kekre (2002)). For a detailed analysis of these papers and how they used IS work, please refer to Appendix II.

²⁴ Although the results of Hypothesis 4 suggested that IS is not contributing significantly to Marketing, initial analysis suggested that Marketing is drawing upon IS' work in the areas of e-commerce, e-markets and interorganizational systems.

IS' contribution to Computer Science. The CS work point emphasizes technological structures and their deployment. The following IS research streams inform the Computer Science discipline: research on group decision support systems and expert systems (as used by Aiken and Sheng (1991)), interorganizational information systems (as used by Hart and Estrin (1991)), and the use of technology in organizations (as used by Markus (1994a)). For a detailed analysis of these papers and how they used IS work, please refer to Appendix III.

Limitations

Limitations of this study are noted below. First, the use of sociometrics is based on the assumption that bibliographic citations can be taken as surrogates for constructing social reality. Furthermore, bibliometric citation analysis does not control for author preferences. Such controls are exercised by our major publication outlets and their "gatekeepers" in terms of what is acceptable and publishable in a given outlet. However, such problems can be alleviated by selecting only the premium journals in each discipline. These articles in these journals are assumed to reflect the best work at that work point. If an IS researcher publishes "outside the field," we find that the work reflects the work point of publication. Second, as both Cheon et al. (1992) and Culnan and Swanson (1986) note, the results can be conditioned by the pool of journals selected in a particular discipline. While we carefully selected the journals, it is possible that our journal basket choices might have influenced the results, as demonstrated in Chua et al. (2003). Third, our choice of reference disciplines (including the two new ones) is not exhaustive. However, we believe progress with respect to these disciplines is a good indicator of the field's evolving maturity. Fourth, this study relied only on journals published in North America (*MISQ*, *ISR*, *JMIS*). Are these journals reflective of other (European and Asian) perspectives on IS research? Given that the editorial boards for these journals reflect these constituencies, there is no reason to believe that the trends presented here would not hold for other research traditions. However, a definitive claim on this is beyond the scope of the study. Finally, we have adopted a "mainstream" definition of IS research that influenced the selection of articles at the non-IS work points. While we did not encounter much difficulty in identifying IS articles, some might view this as a limited view of IS. We therefore acknowledge that the results are subject to our assumptions regarding what is mainstream IS research.

Conclusion

Introspective studies are important for any academic discipline as they provide a status report on the field. We attempted to provide such a report on the evolution of IS discipline believing that this is particularly important in the current environment of raging debates regarding our discipline's identity, core, and contribution. We believe this study provides a better understanding of the positioning of IS within its constellation of disciplines. Specifically, the study:

- replicates and extends prior hypotheses by retaining hypotheses from the original study in this vein as well as adding new ones to represent the changing context of our discipline;

- extends in time this prior work by considering the fourteen years passed since the last study. While the previous two studies have covered the period from 1980-1989, the present paper covers the critical period from 1990– 2003;
- extends the work points of prior studies from the three conventional “foundational fields” i.e. Management Science, Organizational Science, and Computer Science to five, adding Marketing and Economics as two new reference disciplines; and
- attempts to qualitatively explore how IS work is being used by other disciplines.

In conclusion, we see this study as the first to engage in extensive socio-metric analysis and conclude our field is turning the tables on its reference disciplines and becoming an important intellectual engine for these disciplines as well as others. This is a positive reflection on the increasing quality of IS research as we continue our quest to establish centrality in research pertaining to our domain. While our input sources reflect the changing business environment, the results of this study indicate that we are drawing more upon our own work and thereby increasing control of our knowledge construction. Perhaps it is time to focus our energy in colloquia or other forums away from a defensive stance of justifying our existence, and toward a more proactive stance of how to accelerate this progress and knowledge contribution.

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Appendix I

Organization Science Work Point			
Title of the Article	Summary	Cited References	Synthesis of how IS work is used
<p>The Dynamics of Alignment: Insights from a Punctuated Equilibrium Model, – Sabherwal et al. (2001)</p>	<p>Importance of alignment among two or more organizational dimensions for effective organizational performance is well recognized. However, the dynamics of this alignment has received little notice. This article addresses this gap.</p>	<ul style="list-style-type: none"> • Chan et al. (1997), Business Strategic Orientation, Information Systems Strategic Orientation, and Strategic Alignment. <i>ISR</i> • Fiedler and Grover (1996), An Empirically Derived Taxonomy of Information Technology Structure and Its Relationship to Organization Structure. <i>JMIS</i> • Rackoff et al. (1985), Information systems for competitive advantage: Implementation of a planning process. <i>MISQ</i> • King (1978), Strategic Planning for Management Information Systems. <i>MISQ</i> • Chan et al. (1997) • Orlikowski (1993), CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development, <i>MISQ</i>. • Newman and Robey (1992), A Social Process Model of User-Analyst Relationships, <i>MISQ</i> • Chan et al. (1997) • Ein-Dor and Segev (1982), Organizational Context and MIS Structure: Some Empirical Evidence, <i>MISQ</i>. • Brown (1997), Examining the Emergence of Hybrid IS Governance Solutions: Evidence from a Single Case Site, <i>ISR</i> 	<p>The authors used these two articles to build a holistic view of alignment – based upon both strategy and structure</p> <p>Builds on these previous works in developing the theoretical arguments.</p> <p>These articles support the authors' contention to use punctuated equilibrium model.</p> <p>These articles provide the definitional terminology for “strategic alignment” and “structural alignment”.</p> <p>Draws on these articles for “IS structure”</p>

Organization Science Work Point			
Title of the Article	Summary	Cited References	Synthesis of how IS work is used
		<ul style="list-style-type: none"> Brown and Magill (1994), Alignment of the IS Functions with the Enterprise: Toward a Model of Antecedents, <i>MISQ</i>. Tavakolian (1989), Linking the Information Technology Structure with Organizational Competitive Strategy: A Survey, <i>MISQ</i> Rackoff et al. (1985) Orlikowski (1993) 	<p>construct.</p> <p>Draws on these articles for “IS strategy” construct.</p> <p>Uses this article for qualitative data analysis.</p>
Bridging Space over Time: Global Virtual Team Dynamics and Effectiveness – Maznevski and Chudoba (2000)	Develops a theory of global virtual team dynamics and effectiveness. Proposed that effective global virtual team outcomes are a function of appropriate interaction incidents and the structuring of those incidents into a temporal rhythm.	<ul style="list-style-type: none"> Ives and Jarvenpaa (1991), Applications of Global Information Technology: Key Issues for Management, <i>MISQ</i> Jarvenpaa et al. (1998), Is Anybody out There? Antecedents of Trust in Global Virtual Teams, <i>JMIS</i> Hightower and Sayeed (1996), Effects of Communication Mode and Prediscussion Information Distribution Characteristics on Information Exchange in Groups, <i>ISR</i> 	<p>Provides the background that - technology enables globally distributed people to collaborate.</p> <p>While defining global virtual teams, the work of these authors is considered</p>

Organization Science Work Point			
Title of the Article	Summary	Cited References	Synthesis of how IS work is used
		<ul style="list-style-type: none"> • Smith and Vanecek (1990), Dispersed Group Decision Making Using Nonsimultaneous Computer Conferencing: A Report of Research, JMIS • Ocker and Hiltz (1995/1996), The Effects of Distributed Group Support and Process Structuring on Software Requirements Development Teams: Results on Creativity and Quality, JMIS • Ocker et al. (1998), Effects of Four Modes of Group Communication on the Outcomes of Software Requirements Determination, JMIS • Turoff et al. (1993), Distributed Group Support Systems, MISQ • Jarvenpaa et al. (1998) • Hiltz et al. (1991), Group Decision Support: The Effects of Designated Human Leaders and Statistical Feedback in Computerized Conferences, JMIS • DeSanctis and Jackson (1994), Coordination of Information Technology Management: Team-Based Structures and Computer-Based Communication Systems, JMIS • Zack (1993), Interactivity and Communication Mode Choice in Ongoing Management Groups, ISR 	<p>Literature review on these technology-supported distributed teams studies lays foundation (partially) for the present authors to use Adaptive Structuration Theory to develop a conceptual model for this foundation.</p>
Reconceptualizing the Context-Design Issue for the Information	The authors develop theory for predicting the distribution of		The authors draw on literature from IS, Strategic Management, and Organizational

Organization Science Work Point			
Title of the Article	Summary	Cited References	Synthesis of how IS work is used
Systems Function – Brown and Magill (1998)	decision making between the corporate and business-unit levels of management for a firm’s system development activity	<ul style="list-style-type: none"> • Weill and Olson (1989) An Assessment of the Contingency Theory of Management Information Systems, JMIS • Brown and Magill (1994), Alignment of the IS Functions with the Enterprise: Toward a Model of Antecedents, MISQ • Allen and Boynton (1991), Information Architecture: In Search of Efficient Flexibility, MISQ • Tavakolian (1989), Linking the Information Technology Structure with Organizational Competitive Strategy: A Survey, MISQ • Brown and Magill (1994) • Dixon and John (1989), Technology Issues Facing Corporate Management in the 1990s, MISQ • Olson and Chervany (1980), The Relationship between Organizational Characteristics and the Structure of the Information Services Function, MISQ. 	<p>Theory to develop their theory. It is clear that without the input from IS field, the authors would not have been able to develop the theory or the developed theory would have been considerably different.</p> <p>These studies help the authors of present study identify gaps in research on the alignment of IS function from context-design fit perspective, and therefore provides the motivation for the study.</p> <p>These studies provide the terminology (centralized design, decentralized design), and the two sets of IS decisions (i.e. related to Computer & Communication infrastructure, related to systems development) that serve as a foundation</p>

Organization Science Work Point			
Title of the Article	Summary	Cited References	Synthesis of how IS work is used
		<ul style="list-style-type: none"> • Allen and Boynton (1991) • Brown and Magill (1994) • Dixon and John (1989) 	<p>for the present article.</p> <p>The authors of the present article draw on these works to identify the existing IT decision making trends in IS literature.</p>
		<ul style="list-style-type: none"> • Ahituv et al. (1989), Factors Affecting the Policy for Distributing Computing Resources, MISQ • Tavakolian (1989) • Brown and Magill (1994) 	<p>These works provide insights on contingency factors with which IT decision-making designs are aligned. For example, a highly centralized locus of decision making is associated with a more centralized overall firm structure and vice versa.</p>
		<ul style="list-style-type: none"> • Benjamin et al. (1985), Changing Role of the Corporate Information Systems Officer, MISQ • Jarvenpaa and Ives (1991), Executive Involvement and Participation in the Management of Information Technology, MISQ • Brown and Magill (1994) 	<p>These references help the authors develop the 'Strategic Role of IT' as a business-unit level contingency that would affect IT decision-making designs.</p>

Organization Science Work Point			
Title of the Article	Summary	Cited References	Synthesis of how IS work is used
		<ul style="list-style-type: none"> • Brown (1997), Examining the Emergence of Hybrid IS Governance Solutions: Evidence from a Single Case Site, ISR • Boynton et al. (1994), The Influence of IT Management Practice on IT Use in Large Corporations, MISQ • Brown (1997) • Dos Santos et al. (1993), The Impact of Information Technology Investment Announcements on the Market Value of the Firm, ISR • Jarvenpaa and Ives (1990), Information Technology and Corporate Strategy: A View from the Top, ISR • Jarvenpaa and Ives (1991) 	<p>This work helps the authors utilize 'Line Manger IT Knowledge' as a business-unit level contingency that would affect IT decision-making designs.</p> <p>These works stimulate different ways in which the present work could be extended. For example, Boynton et al. (1994) and Brown (1997) identify a number of contingency factors that were not included in the present study, and therefore serve as a basis for future research.</p>
Appropriating Value from Computerized Reservation System Ownership in the Airline	The paper addresses how the owners of Computerized Reservation Systems (CRS)		In general the authors draw on literature from IS, Organization Theory, and Economics to understand how firms can benefit from investing in Information

Organization Science Work Point			
Title of the Article	Summary	Cited References	Synthesis of how IS work is used
Industry – Duliba et al. (2001)	that are deployed in travel agencies could appropriate value from the systems	<ul style="list-style-type: none"> • Mata et al. (1995), "Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis, MISQ • Clemons and Row (1988), McKesson Drug Company: A Case Study of Economost-- a Strategic Information System, MISQ • Davern and Kauffman (2000), Discovering Potential and Realizing Value from Information Technology Investments, JMIS 	<p>Technologies.</p> <p>The authors not only find results that are consistent with Mata et al. (1995) – i.e. the only resource-based information technology advantage comes from unique information technology management skills; but also present other ways to obtain resource-based advantages with information technologies.</p> <p>The authors use the case of McKesson's Economist system as an example of IT innovations through which firms create competitive advantage.</p> <p>Uses the idea of collateral benefits. The greater the distance between where the IT investment occurs and where benefits appear; the benefits are referred to as collateral benefits.</p>

Organization Science Work Point			
Title of the Article	Summary	Cited References	Synthesis of how IS work is used
		<ul style="list-style-type: none"> Copeland and McKenney (1988), Airline Reservations Systems: Lessons From History, MISQ Kauffman et al. (2000), Opening the 'Black Box' of Network Externalities in Network Adoption, ISR Venkatraman and Zaheer (1990), Electronic Integration and Strategic Advantage: A Quasi-Experimental Study in the Insurance Industry, ISR Weill (1992), The Relationship Between Investment in Information Technology and Firm Performance: A Study of the Valve Manufacturing Sector, ISR Barua et al. (1995), Information Technologies and Business Value - an Analytic and 	<p>One of the earliest works on CRS. The authors use this work (examples, statistics, arguments, methods, and definition of 'halo effect' in CRS) to develop research framework.</p> <p>Since information technology innovations have weak value appropriability, innovators need to develop cospecialized assets. This work helps the authors in developing the 'cospecialized asset' arguments.</p> <p>Utilizes the analysis approach used in this work</p> <p>These works are used in reviewing the previous work on IT value research.</p> <p>The present authors discuss the 'reverse</p>

Organization Science Work Point			
Title of the Article	Summary	Cited References	Synthesis of how IS work is used
		<p>Empirical-Investigation, ISR</p> <ul style="list-style-type: none"> • Bakos (1991b), A Strategic Analysis of Electronic Marketplaces, MISQ • Johnston and Vitale (1988), Creating Competitive Advantage with Interorganizational Information System, MISQ 	<p>causation' challenge raised by Weill (1992).</p> <p>Drawing on these authors, the present article argues that the results from their study i.e. technological innovation of CRS could be applicable to the new technological innovation like World Wide Web.</p>
<p>Mitigating Underinvestment through an IT-Enabled Organization Form – Nault (1997)</p>	<p>This paper discusses how IT can enable a new form of the horizontal networked organization.</p>	<ul style="list-style-type: none"> • Nault and Dexter (1995), Added Value and Pricing with Information Technology, MISQ • Bakos (1991a), Information Links and Electronic Marketplaces: The Role of Interorganizational Information Systems in Vertical Markets, JMIS • Clemons and Weber (1996), Alternative Securities Trading Systems: Tests and Regulatory Implications of the Adoption of Technology, ISR 	<p>The authors uses the concept of 'Ownership of Customers' described in this work.</p> <p>Based on these articles, the author argues that the new organization form developed in this article could be applied to electronic markets, and electronic data interchange situations.</p>

Appendix II

Management Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
<p>Investigating the Level of End-User Development and Involvement Among Time-Based Competitors – Rondeau et al. (2002)</p>	<p>Suggests that rich information intensive “internal” environment is a necessity to reduce response time and customization capabilities for product development and manufacturing practices</p>	<ul style="list-style-type: none"> • Barki and Hartwick (1994), Measuring User Participation, User Involvement, and User Attitude, <i>MISQ</i> • Brown and Magill (1994), Alignment of the IS Functions with the Enterprise: Toward a Model of Antecedents, <i>MISQ</i> • Harrison and Rainer Jr. (1992), The Influence of Individual Differences on Skill in End-User Computing, <i>JMIS</i> • Nelson (1991), Educational Needs as Perceived by IS and End-User Personnel: A 	<p>Supports the idea that high levels of time based product development and manufacturing practices related to high levels of end user capabilities and end user involvement in IS activities</p> <p>Provides arguments to support authors contention that the IS function needs to be aligned with the core business processes and if competitiveness is to be improved in time based development of manufacturing practices and products</p> <p>Supports the notion that end user involvement in IS activities reduces resistance to organizational change</p> <p>Supports the notion that end user training involves</p>

Management Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
		Survey of Knowledge and Skill Requirements, <i>MISQ</i>	developing technical and reasoning skills that are fundamental to Time based development of products and manufacturing abilities
Exploring the Importance of Business Clockspeed as a Moderator for Determinants of Supplier Network Performance – Guimaraes et al. (2002)	Explores that the effective use of IT and the depth of company relationships with suppliers has an effect on network supplier performance	<ul style="list-style-type: none"> • Bergeron et al. (1991), Identification of Strategic Information Systems Opportunities: Applying and Comparing Two Methodologies, <i>MISQ</i> • Rackoff et al. (1985), Information Systems For Competitive Advantage: Implementation of a Planning Process, <i>MISQ</i> • Magal et al. (1988), Critical Success Factors for Information Center Managers, <i>MISQ</i> <ul style="list-style-type: none"> • Mukhopadhyay et al. (1995), Business Value of Information Technology: A Study of Electronic Data Interchange, <i>MISQ</i> • Jelassi and Figon (1994), Competing through EDI at Brun Passot: Achievements in France and Ambitions for the Single European Market, <i>MISQ</i> <ul style="list-style-type: none"> • Lee and Kim (1999), Effect of Partnership Quality on IS Outsourcing Success: Conceptual Framework and Empirical Validation, <i>JMIS</i> • Bensaou (1997), Interorganizational Cooperation: The Role of Information 	<p>This work argues that IT reduces transaction and coordination costs and improves supplier network performance. Costs of transportation, obsolete inventory, and Inventory turnover are reduced due to IT</p> <p>Provides arguments for why IT improves depth of partnerships by tying suppliers and companies closely and providing real time exchange of information</p> <p>This work provides theoretical support for how IT can improve sourcing relationships in presence of highly</p>

Management Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
		Technology - an Empirical Comparison of US and Japanese Supplier Relations, <i>ISR</i>	uncertain environments (high clockspeeds)
Modeling Information Manufacturing Systems to Determine Information Product Quality - Ballou et al. (1998)	The study presents a set of ideas, tools, concepts, models, and procedures appropriate for information manufacturing systems that can be used to determine quality of information products delivered, transferred to customers	<ul style="list-style-type: none"> Wang and Strong (1996), Beyond Accuracy: What Data Quality Means to Data Consumers, <i>JMIS</i> Ahituv (1980), A Systematic Approach Toward Assessing the Value of an Information System, <i>MISQ</i> Ballou and Pazer (1995), Designing Information-Systems to Optimize the Accuracy-Timeliness Tradeoff, <i>ISR</i> 	<p>Uses the four dimensions in this paper associated with data quality to improve information manufacturing systems</p> <p>The IS research here helps understand what is data quality, how to achieve data quality, and intended and unintended consequences when data quality is affected</p>
Information Systems Adaptation and the Successful Implementation of Advanced Manufacturing Technologies - Frohlich and Dixon (1999)	Adaptations of Advanced Manufacturing Technologies (AMT) are often required to gain success. Study investigates four types of adaptations, It is found that the most significant		The authors use IS literature to understand the concept of how technology interacts with social settings to affect success. Interactions between technology and organization affect attitudes, motivations, reward systems, and authority structures among others

Management Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
	determinant of success in AMT is information systems adaptation	<ul style="list-style-type: none"> • Franz et al. (1986), User Response to an Online Information System: A Field Experiment, MISQ • Mason et al. (1997), Developing an Historical Tradition in MIS Research, MISQ • Bostrom and Heinen (1977), MIS Problems and Failures: A Socio-Technical Perspective, MISQ • Davenport and Stoddard (1994), Reengineering: Business Change of Mythic Proportions? MISQ • Guha and Grover (1997), Business Process Change and Organizational Performance: Exploring an Antecedent Model, JMIS • Huizing and Koster (1997), Balance in Business Reengineering: An Empirical Study 	<p>Collection of Information technology, people, and structure forms a socio-technical web that leads to success – Analogous to Kling and Scacchi's (1982) "web of computing" concept. This is also referred to as joint optimization or mutual adaptation to gain success.</p> <p>Uses the concepts of socio-technical interaction between IT and organizations to understand Business process change and hence the success of advanced manufacturing technologies.</p> <p>Supports ideas regarding the role of IT in improving coordination and communication.</p>

Management Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
		<ul style="list-style-type: none"> of Fit and Performance, JMIS • Janz and Wetherbe (1997), Reengineering the Systems Development Process: The Link between Autonomous Teams and Business Process Outcomes, JMIS • Grover and Jeong (1995), The Implementation of Business Process Reengineering, JMIS • Kettinger and Grover (1995), Special Section: Toward a Theory of Business Process Change Management, JMIS • Kettinger et al. (1997), Business Process Change: A Study of Methodologies, Techniques, and Tools, MISQ 	<p>Consistency of information, and knowledge shared across organization. The need to use MIS design principles in developing advanced manufacturing technologies</p> <p>Use the theoretical framework proposed by in these papers to understand the mediating role of change management and process management between change environment and outcomes; IT change management</p>
Strategic and Operational Benefits of Electronic Integration in B2B Procurement Processes – Mukhopadhyay	Assesses the strategic and operational benefits of electronic integration in procurement process	<ul style="list-style-type: none"> • Clemons and Row (1988), McKesson Drug Company: A Case Study of Economost-- a Strategic Information System, MISQ • Venkatraman and Zaheer (1990), Electronic Integration and Strategic Advantage: A Quasi-Experimental Study in the Insurance Industry, ISR 	These articles support the authors ideas that technology integration leads to differential (for instance additional acquisitions) gains and expansion of business activities due to efficient

Management Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
and Kekre (2002)		<ul style="list-style-type: none"> • Mukhopadhyay et al. (1995), Business Value of Information Technology: A Study of Electronic Data Interchange, MISQ • Premkumar and Ramamurthy (1994), Implementation of Electronic Data Interchange: An Innovation Diffusion Perspective, JMIS • Riggins and Mukhopadhyay (1994), Interdependent Benefits from Interorganizational Systems: Opportunities for Business Partner Reengineering, JMIS 	<p>transactional processing Technology characteristics should be matched with customer characteristics (technology-customer selection) to improve outcomes</p> <p>Supports the notion of IT implementation leading to stronger business relationships between suppliers and customers</p> <p>Article explains how IT can help suppliers by developing preferential contact with buyers, Buyers return favors to preferred supplier in return for integrating businesses</p>

Appendix III

Computer Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
Integrating Expert Systems with Group Decision Support Systems - Aiken et al. (1991)	The paper examines the synergy between GDSS and ES and suggests that doing so might enhance the quality of group communication, negotiation, and collaborative work	<ul style="list-style-type: none"> Sprague Jr. (1980), A Framework for the Development of Decision Support Systems, <i>MISQ</i> Dennis et al. (1988), Information Technology to Support Electronic Meetings, <i>MISQ</i> Kottemann and Konsynski (1984), Information Systems Planning and Development: Strategic Postures and Methodologies, <i>JMIS</i> Huber (1984), Issues in the Design of Group Decision Support Systems, <i>MISQ</i> Turban and Watkins (1986), Integrating Expert Systems and Decision Support Systems, <i>MISQ</i> 	<p>Uses IS research to understand the effects of rationally designed GDSS on individuals and groups. Develops the understanding that due to interaction of technology and social factors, issues like task, context, and technical limitations can impede desired outcomes</p> <p>IS research helps in outlining social issues encouraging group members to participate in sessions, enforce formal meeting procedures, Integrate organizational and environmental information, and technical issues like how to manage complex GDSS technology, understand what tool serves the purpose at hand and selection of tools based on group size, social factors, expertise etc.</p>

Computer Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
		<ul style="list-style-type: none"> • Straub Jr. and Beauclair (1988), Current and Future Uses of Group Decision Support System Technology: Report on a Recent Empirical Study, <i>JMIS</i> • Liu et al. (1990), An Agent for Intelligent Model Management, <i>JMIS</i> • McIntyre et al. (1986), Automating Planning Environments: Knowledge Integration and Model Scripting, <i>JMIS</i> 	<p>Expands and uses IS work by extending the concepts used to integrate ES and DSS and applies them to understand how ES and GDSS can be integrated</p> <p>Uses IS work to understand that pure rationale of efficiency improvements cannot ascertain success of GDSS, Rather, it is the range of functionality provided by the GDSS and its congruence with the tasks (Note here it is also synonymous with the task technology fit idea proposed by Goodhue and Thompson (1995)). Additionally, IS work is utilized by realizing that USE is also an important factor in the success of a GDSS no matter how well it is built and that use and task technology fit are intricately related to each other</p>
Inter-Organization Networks, Computer Integration, and Shifts in Interdependence: The Case of the Semiconductor	Inter-organization networks provide significant opportunities for improving coordination between firms	<ul style="list-style-type: none"> • Barrett and Konsynski (1982), Inter-Organization Information Sharing Systems, <i>MISQ</i> • Clemons and Row (1988), McKesson Drug Company: A Case Study of Economost-- A Strategic Information 	<p>Treats organizations as "information processing systems" based on this work.</p> <p>Relies on IS work to understand how IT can support increased coordination and reduce product</p>

Computer Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
Industry - Hart and Estrin (1991)	engaged in mutually dependent activities. This study presents the use and impact of ION's in semiconductor industry. ION increases inter-organization coordination and shifts the nature of interdependence between firms	<p>System, JMIS</p> <ul style="list-style-type: none"> • Venkatraman and Zaheer (1990), Electronic Integration and Strategic Advantage: A Quasi-Experimental Study in the Insurance Industry, MISQ • Johnston and Vitale (1988), Creating Competitive Advantage with Interorganizational Information Systems, MISQ 	<p>turn-around times, improve ability to transfer large amount of data across geographically dispersed locations, improve monitoring capability (hence reduce transaction costs), and eliminate redundant and time consuming work</p> <p>Uses IS research to understand differences between lean and rich media, and how ION media characteristics affect coordination and hence the efficiency of the organization. IS work emphasizes the need to establish uniform processing between partners when media characteristics are lean</p> <p>Uses IS work to understand how competitive advantage can be created by establishing both "intra-organizational" networks and "inter-organizational" networks</p>
Finding a Happy Medium: Explaining the Negative Effects of Electronic Communication on Social Life at Work	Alternative theoretical perspectives on the impacts of information technology suggest that		Supports notion that outcomes of use are determined by technology characteristics and outcomes of use are determined by people characteristics, and then,

Computer Science Work Point			
Title of Citing Article	Summary	Cited References	Synthesis of how IS work is used
- Markus (1994b)	“assumed outcomes” are not necessarily achieved. This case study attends to users intentional choices to use technology and the unpredictable usage patterns that emerge when users interact with the technology to explain undesired outcomes of IT impact	<ul style="list-style-type: none"> • Lee (1989), A Scientific Methodology for MIS Case Studies, MISQ • Orlikowski and Baroudi (1991), Studying Information Technology in Organizations: Research Approaches and Assumptions, ISR • Orlikowski and Robey (1991), Information Technology and the Structuring of Organizations, ISR 	<p>Uses IS work to understand that technology can have both positive and negative impacts based upon what and how phenomena are investigated.</p> <p>Uses IS research to understand the incompleteness of rational actor perspective, and instead suggests that how people use technology and what they try to accomplish with it are as likely to determine negative behavior (Negative behavior is not purely due to technology characteristics)</p> <p>Uses the emergent IS perspective to establish that effect of technology use result from unpredictable interactions among technology characteristics, user intentions, and social definitions</p>

About the Authors

Varun Grover is the William S. Lee (Duke Energy) Distinguished Professor of IS in the Department of Management, Clemson University. Previously he was a BP Foundation Fellow and Professor of Information Systems at the University of South Carolina. Dr. Grover has published extensively in the IS field, with three books and over 150 publications in refereed journals. His current research focuses on the impact and effectiveness of IS at the organizational and market levels. A number of recent articles have ranked him among the top five researchers based on publications in top IS journals over the past decade. He is currently serving as Senior Editor for *MIS Quarterly*, *JAIS* and *Database* and as Associate Editor for the *Journal of MIS*, *Journal of Operations Management*, *International Journal of E-Commerce*, and numerous others. Dr. Grover has also received recognitions for his research from the Decision Sciences Institute, PriceWaterhouse Coopers, AIS and Anbar Intelligence, and is the recipient of a number of teaching awards for courses taught at the MBA and doctoral levels.

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