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Information Systems, Dominant Paradigms, and Emerging Concepts: A Community Clustering Analysis of the Highest Impact Topics in Information Systems Research

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Introduction

Future research directions for the Information Systems (IS) discipline have been debated throughtout our history, from Banville and Landry (1989) through Orlikowski and Iacono (2001), Benbasat and Zmud (2003), and the essay collection in King and Lyytinen (2006), to recent contributions by Walsham (2012) and many others. Each proposal for the future is necessarily based on an assessment of the past. Has IS research been too focused on a single set of topics and approaches, or is it too eclectic? Is the challenge to create a more cumulative tradition through a widely shared research paradigm? Or has IS research been highly diverse, and the challenge is to preserve that diversity?

The contribution of this paper is to provide a preliminary analysis of how diverse IS research has been, based on the research topics that have had the highest impact, as measured by academic citations. Does IS have a dominant paradigm? Our analysis argues that the impact of IS research has been dominated by a single research paradigm, which we label as 'IS acceptance'. This contrasts with a widespread assumption that IS research is highly diverse, or a 'fragmented adhocracy' (Banville and Landry, 1989), and in need of a common theoretical core (e.g., Benbasat and Zmud, 2003). While the sum total of IS research may indeed be diverse, citation impact is dominated by a specific topic area throughout the history of the discipline.

When this analysis is repeated for the most recent decade, the highest impact topics are still dominated by 'IS acceptance', but are joined by three new topics, 'IS and design', 'IS and strategy', and 'IS and expertise'. Each of these high-impact topic areas provide a potential area of future strength for the IS discipline, and perhaps taken together could be seen as the new core of a high impact discipline.

The paper begins with a brief review of the 'IS legitimacy' debate literature, with an emphasis on how the analysis used in this paper differs from previous attempts to map the intellectual structure of the IS discipline. We then explain the major methodological choices: drawing from a wide range of publication outlets, rather than only the most prestigious IS journals; the assumption of a power law distribution for citations; and the use of a community structure algorithm from network analysis to identify research paradigms and emerging ideas. Our analysis identifies the dominant research paradigm, and the high-impact topics emerging from that paradigm.

Previous Literature

Questions about Information Systems (IS) research strategy have been most thoroughly debated in the literature on the academic legitimacy of the IS discipline. This debate, which can be dated back as far as Banville and Landry (1989), is arguably as old or older than the field itself, given that the first ICIS conference was in 1990. A key reference point in this debate (Benbasat and Zmud, 2003) framed the IS faculty hiring, curriculum, and enrollment challenges after the dot.com collapse primarily as issues of academic legitimacy in an emerging discipline lacking a sufficiently strong 'theoretical core' to build a cumulative research tradition.

Reactions to Benbasat and Zmud (2003) shaped the IS legitimacy debate over the next decade. While the full extent of these debates cannot be captured here (see the collection in King and Lyytinen (2006) for an

overview), a major issue has been whether to focus future IS research on an agreed-upon theoretical core, or to continue to encourage what was perceived as the diversity of IS research. Weber (2003) argued the case for increasing focus around a set of "powerful, generic" theories to build a cumulative research tradition that would lead to increased legitimacy.

Others, however, objected to the portrayal of IS research diversity as a weakness. Galliers (2003), for example, found "strength in diversity", while others such as Lyytinen and King (2004) argued that the path to legitimacy was through relevance and strong research results, both of which required flexibility and diversity in IS research. Walsham (2012) more recently built upon this argument in claiming that the true goal of IS research, to build a better world, requires both a pluralistic and critical. Robey (2003) put this in the strongest terms when he argued that IS research must "avoid the lure of the dominant paradigm" (p. 353).

Both sides in this debate share a widespread, if unarticulated, belief that IS research is truly diverse. There is only disagreement about whether this is a positive state of affairs, or a negative one. This belief can also be seen in the remarks of the newest AIS President at ICIS 2014, where he remarked that one of his major goals was to maintain the diversity of the IS discipline (Krcmar, 2014).

A related literature to the IS legitimacy debate has been a series of important review articles that assess the state of IS research through a particular theoretical, methodological, or topical lens. Some important examples of this genre include reviews of methods (Orlikowski and Baroudi, 1991), theoretical assumptions about technology (Orlikowski and Iacono, 2001), the main topics and levels of analysis used in IS research (Sidorova et al., 2008), and many others. These review articles are referenced in the IS legitimacy debate to support various arguments for future IS research directions. This type of review article often proceeds by selecting a small set of the most prestigious IS research journals, classifying their published research through some process, then showing a gap or an imbalance in the literature. The presumed future IS research emphasis therefore should be to fill the identified gaps.

This brief overview of previous literature has surfaced two assumptions that deserve to be re-examined. First, is IS research as diverse as is often assumed? Second, there is an assumption that only articles published in a few highly reputable IS research journals should be included in an analysis of the discipline. This is despite the fact that there are much more accurate tools available today to identify the highest impact IS research, regardless of where papers happen to be published (e.g., Harzing, 2013).

Methods

Similarly to other high-level reviews of the IS literature, citation analysis is used to answer questions about the intellectual structure of IS research. This study used citation information from the Google Scholar database to identify the 20 most cited IS research papers of all time, the 20 most cited papers published more recently (since 2004), and the citation relationships between these papers. On November 6 and 7, 2014, the search term "information systems" was used to collect 20 pages (200 papers) worth of search results. In a typical search result page, the most frequently cited papers tend to appear earlier.

For the 20 most cited papers, 'snowball' sampling was used to investigate whether any paper that cited a top 20 paper had enough citations to replace an article on the top 20 list. A similar 'snowball' approach was used to investigate any journal or publication outlet included on the current top 20 list. Once this process revealed no new publications, the two top 20 lists were created (Appendix A and B). To make the top 20 list of the all-time most cited IS papers, 3,000 or more citations were required. To be included in the more recent top 20 list, 1,000 or more citations were required. A community structure algorithm known as Girvan-Newman (Newman and Girvan, 2004) was executed on the network of citations between top papers to identify topical clusters in IS research.

Three particular methodological choices differ from other IS research reviews. First, this study uses the broadly inclusive Google Scholar database, rather than a list of pre-selected IS research journals. Early studies of Google Scholar raised questions about the quality and the consistency of its data for use in citation analysis (e.g., Falagas et al., 2008). However, more recent research suggests that Google Scholar is more comprehensive and less biased than competing databases. Harzing (2013) argues that Google Scholar is of comparable quality to the well-known Web of Science, particularly in the social sciences and computer science. The advantage of a more inclusive approach can be seen in Tables 1 and 2, where

entries can be found that are published outside the usual set of the 6 or 8 most prestigious IS journals. The analysis of the most important publications in IS research is based on citation impact, rather than publishing venue.

Without limiting the search to a small number of journals, a cutoff point needed to be chosen for how many papers to include. Following Harzing (2013), we chose the 20 most cited papers for our preliminary analysis. This method assumes that academic citation patterns in IS research are similar to other disciplines in following a power law distribution, meaning that a small set of mega-publications tend to dominate the distribution of citations. Power law distributions have been found to apply to many real-world phenomena, including scientific citations (e.g., Clauset et al., 2009). In a power law distribution, the citation pattern of an 'average' paper is not an accurate reflection of an 'average' impact in the same way that life in an 'average' sized city in the United States (i.e., a population of 8,000) is not an accurate reflection of the urban experience of most Americans. It is more meaningful in these circumstances to focus on the top end of the distribution only.

A third methodological choice was to treat paper citations as a network, and use a community structure algorithm from social network analysis to identify particular thematic schools of IS research literature. This is an approach we have not found in earlier literature. The argument for this approach is that detecting the presence of impactful groupings in IS research is better treated as a network clustering problem than a problem of co-citation correlations between individual authors (as in Sidorova et al., 2008, and many other review papers). For this analysis, a divisive rather than an agglomerative community structure algorithm was chosen, follwing the arguments that divisive methods typically handle peripheral nodes more effectively (gephi.org, 2014), as multiple peripheral nodes were expected in the analysis.

The specific community structure algorithm chosen, Girvan-Newman, detects communities by progressively removing edges from the original network. The connected components of the remaining network are defined as the communities. Instead of trying to construct a measure that defines which edges are the most central to communities, the Girvan–Newman algorithm focuses on edges that are most likely between communities. The Girvan-Newman algorithm provides a modularity measure Q, which measures the fraction of edges in the network that connect nodes of the same type (i.e., within-community edges) minus the expected value of the same quantity in a network with the same commu- nity divisions but random connections between the nodes (Newman and Girvan, 2004). If the number of within-community edges matches a random graph, Q will equal 0. The maximum value of Q is 1, with higher values indicating a stronger community structure.

The algorithm produced the community structures with higher Q values indicated in Figures 1 and 3. Labels were assigned to the communities by the researchers, as shown in Figures 2 and 4.

Analysis Part I: Is There a Dominant Paradigm in Information Systems?

A major assumption underlying previous debates about future IS research strategy is that IS research is highly diverse. An analysis of the citation network for the 20 most cited IS papers is more supportive of the opposite view, that the majority of highly cited papers form a single subgroup.

Figure 1 shows the citation network of the 20 most cited papers in IS research. Each box represents an IS research publication, with the labels listed in Appendix A. The area of each box corresponds to the number of citations received by that paper. Applying the Girvan-Newman community structure algorithm resulted in the highest modularity score (Q=0.238) for a four subgroup solution. Each of the four subgroups is shown with a dotted line box.

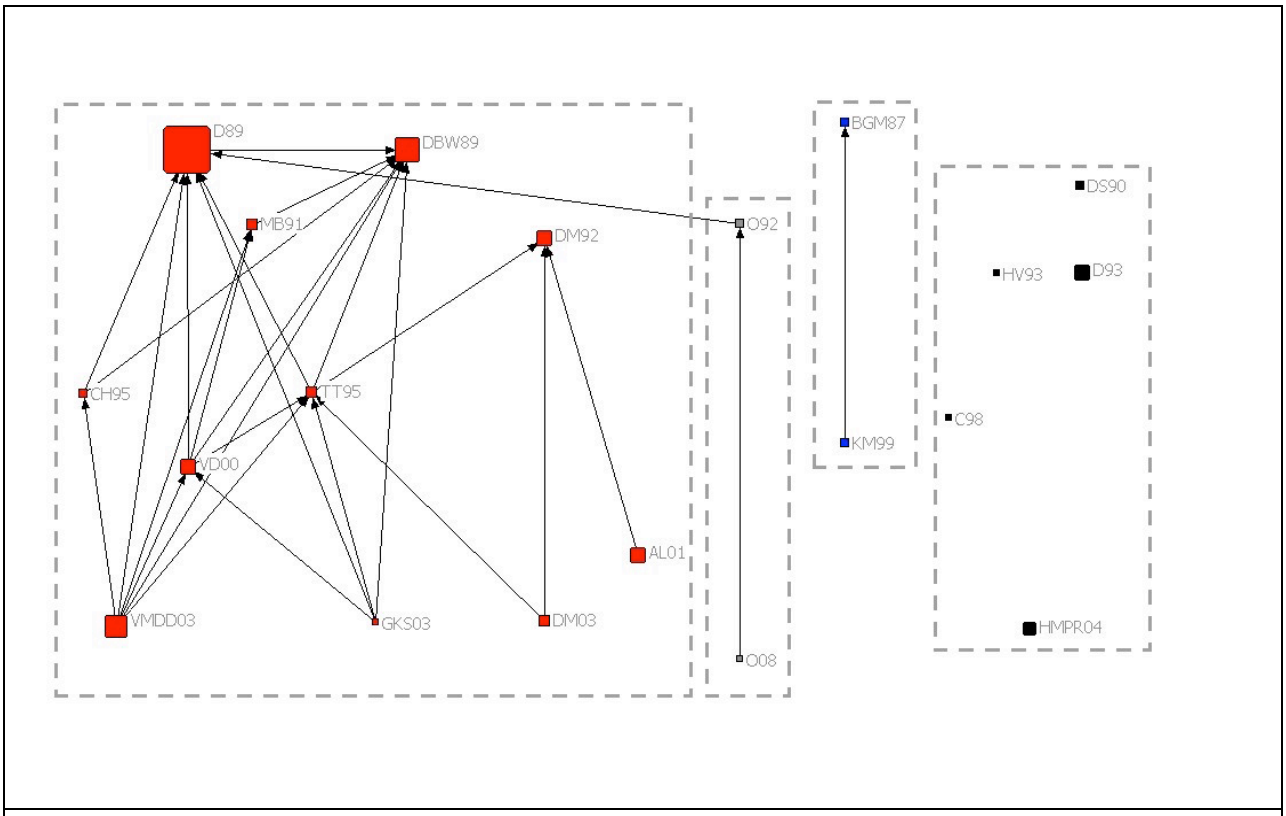

Figure 1. Citation Graph of Top 20 Most Cited Papers in Information Systems Research, by Subgroup

Figure 1 is consistent with the claim that the IS discipline does, in fact, have a dominant paradigm. Our label for the bulk of this research paradigm is 'IS acceptance', based on the titles and content of eight of these papers. The entire subgroup can be seen as a single community, but given the distinctive content of three of the papers, two other topical subgroups were identified. These were labelled as having the topics of 'IS success model' for papers [DM92] and [DM03], and 'knowledge management' for paper [AL01], but are shown as overlapping with the 'IS acceptance' community to illustrate membership in the same subgroup in the community structure analysis. The labelling of distinctive topic areas is shown in Figure 2.

Two other topic areas corresponded to the second and third communities from the analysis. A second community, labelled as 'duality of technology' based on papers [O92] and [O08], is connected to the dominant 'IS acceptance' paradigm via citations, while a third grouping labelled as 'qualitative methods' based on papers [BGM87] and [KM99] is not.

A fourth subgroup, consisting of topically unrelated papers unconnected by citation relationships, were separately labelled as 'quantitative methods' based on the content and title of paper [C98], 'reengineering' based on papers [DS90] and [D93], 'strategic alignment' based on paper [HV93], and 'design science' based on paper [HMPR04].

Figure 2 provides a visual interpretation of the structure of high impact IS research, which can be summarized as follows: a dominant paradigm around 'IS acceptance', incorporating the topics of 'IS success' and 'knowledge management', with additional high-impact topics in the realms of technology theory, qualitative and quantitative methods, strategy, design, and reengineering.

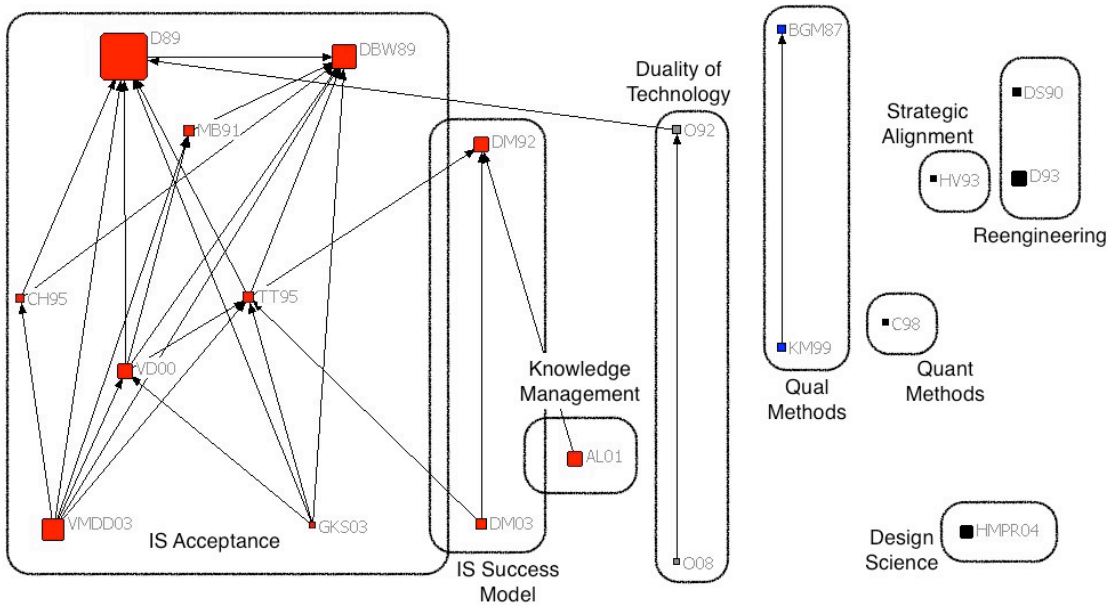

Figure 2. Citation Graph of Top 20 Most Cited Papers in Information Systems Research, by Topic Area

Analysis Part II: Is the Dominant Paradigm Still Influential?

If there is a dominant paradigm in IS research around 'IS acceptance', does it continue to be influential in more recent research? Or have new, highly impactful ideas begun to emerge out of increasing diversity? Figure 3 shows the results of the same analysis of community structure described in the previous section, but applied to the most cited IS research papers since 2004, and as listed in Appendix B. Papers published before the year 2004 are aggregated by their topic areas. Each topic area from the previous analysis is included as a single node in the network. These aggregate nodes can be seen across the top of the diagram in figure 3.

This analysis of community structure reveals a maximum modularity score for a six subgroup solution (Q=0.37). While the total citation count is still weighed heavily toward the dominant paradigm, as can be seen in the large subgroup on the left side of figure 3, an increasing number of subgroups with a more complex set of interactions can be interpreted as evidence that new high-impact topic areas are emerging.

Figure 4 shows an interpretation of the key ideas, or main topic areas, represented by the most cited recent IS research papers. 'IS acceptance' research remains influential, and remains well connected to the overlapping topic areas of 'IS success' and 'quantitative methods'. 'Knowledge management' has become its own distinct subgroup in the more recent period, but still with quite robust citation connections to the dominant 'IS acceptance' subgroup.

A third subgrouping cites the previous 'duality of technology' topic area, but contains a variety of single papers with distinct topics. These topic areas are shown in figure 4 as 'assimilation' for paper [LSHX07], and 'practice lens' for paper [O08]. Due to its title and content, paper [VB08] has been included back within the 'IS assimilation' area. The 'duality of technology' subgroup was more connected to the dominant 'IS assimilation' area than other subgroups in the analysis from the previous section. This analysis of more recent publications shows this subgroup being reconnected with the dominant paradigm.

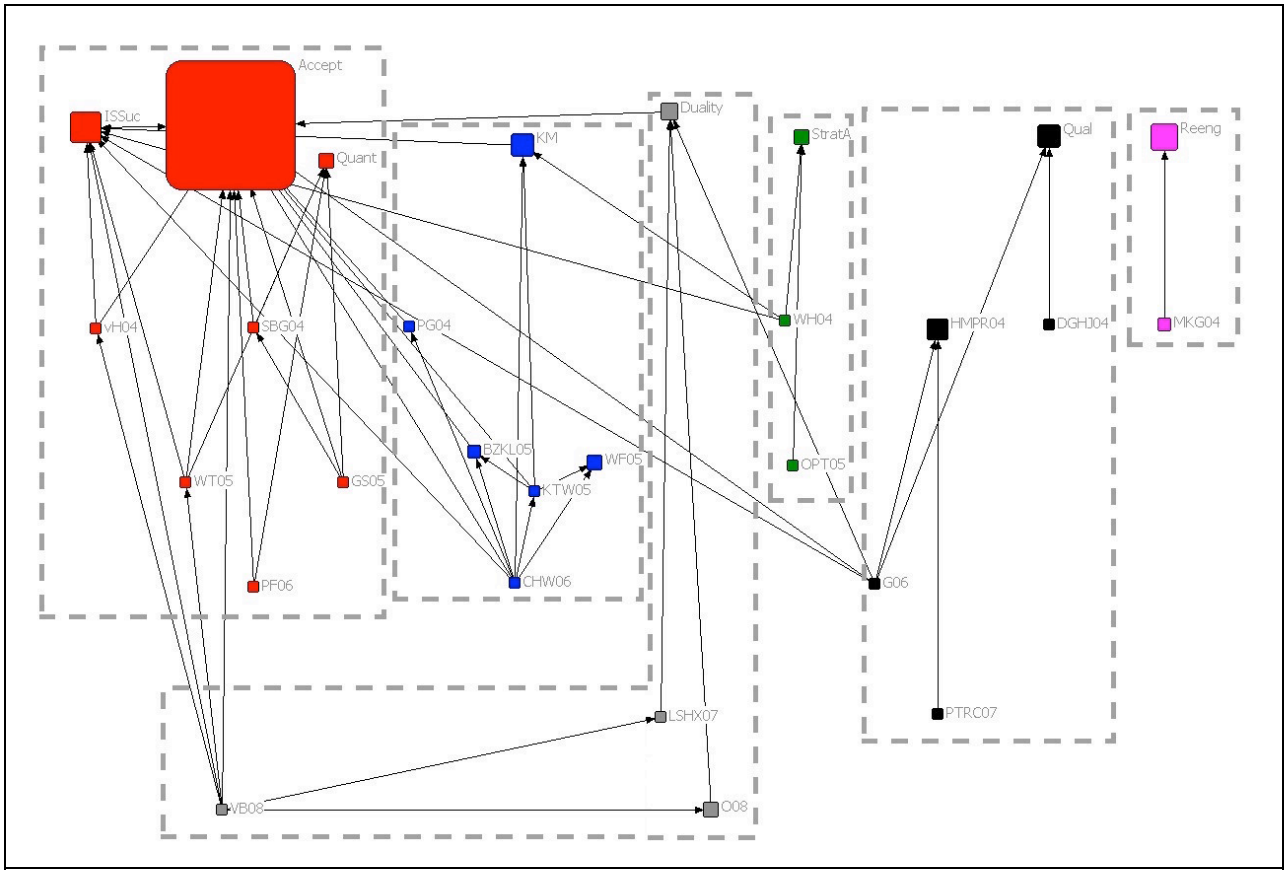

Figure 3. Citation Graph of Top 20 Most Cited Papers in Information Systems Research Since 2004, by Subgroup

A fourth subgroup draws from the 'strategic alignment' topic area in the previous analysis. The two distinct topic areas in this subgroup are labelled as the 'resource based view' for paper [WH04], and 'business models' for paper [OPT05]. Both of these topic areas have a strategy emphasis.

A fifth subgroup contains a more varied set of topics, drawing from both the 'design science' and 'qualitative methods' topic areas in the earlier analysis. Papers [HMPR04] and [PTRC07] are labelled as the continuing 'design science' topic area. One paper, labelled as 'outsourcing' [DGH004], cites the 'qualitative research' tradition. The last paper in this subgroup is a wide-ranging review paper that draws upon multiple previous traditions [G06].

The sixth subgroup, on the right of figure 3, contains a single new paper that draws upon the 'reengineering' topic area. This paper [MKG04] is labelled as 'business value'.

Overall, figure 4 offers a visual interpretation the most recent decade of high-impact IS research. The dominant paradigm of 'IS acceptance' continues to be influential in the most recent decade, both in terms of the number of citations within the paradigm, and citations from key publications outside of the paradigm. Some new high-impact topic areas have emerged. These newer topics have, in many instances, drawn upon one of the main topic areas from the earlier analysis of the most cited IS research papers of all time.

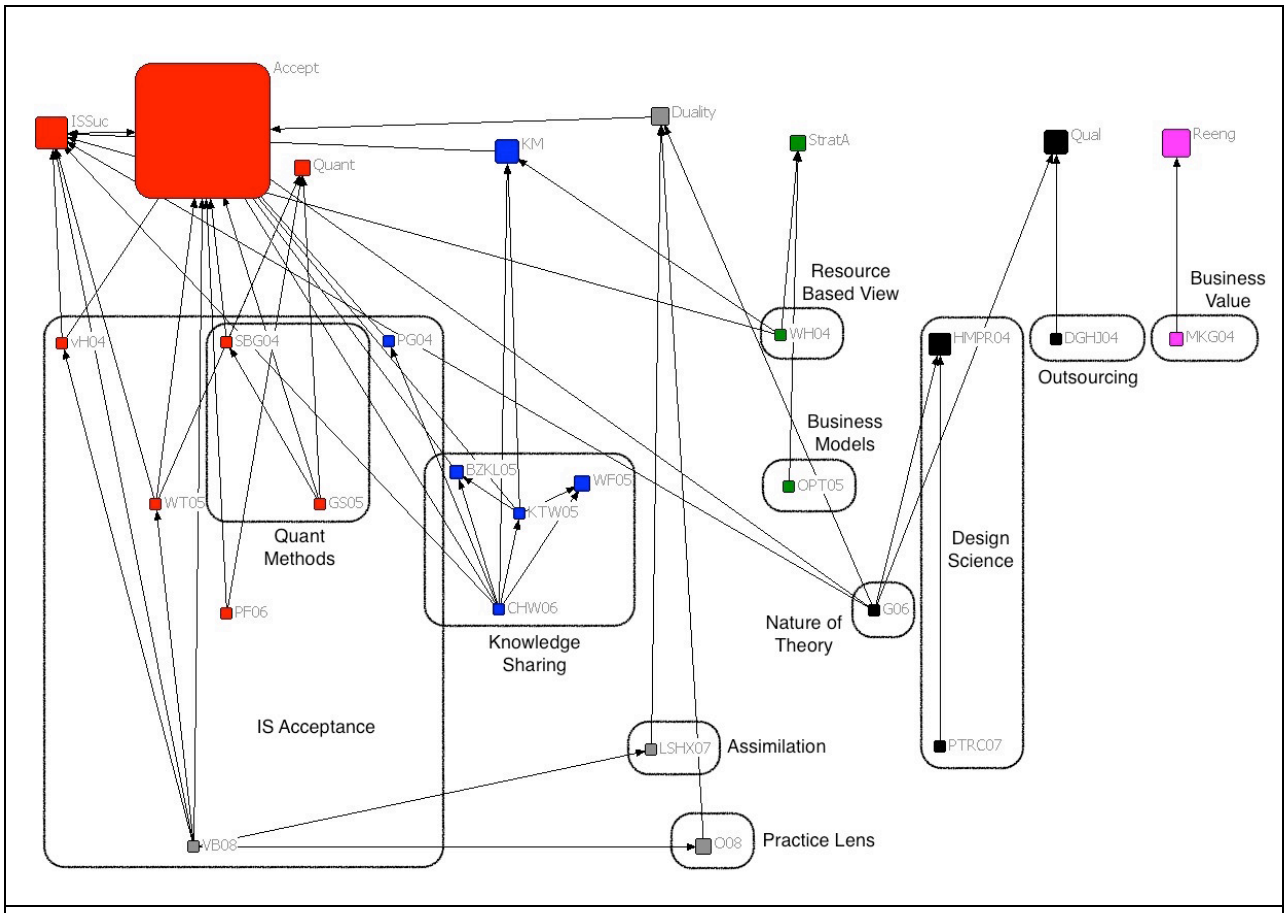

Figure 4. Citation Graph of Top 20 Most Cited Papers in Information Systems Research Since 2004, by Topic Area

Discussion: Dominant Paradigm and Emerging Concepts

The analysis above provides an interpretation of where the IS discipline has created high impact research, and how that ability has evolved more recently. According to this analysis, the dominant paradigm of 'IS acceptance' began with the publication of two key papers in 1989. This dominant paradigm continues to have a powerful influence over IS research. The small number of top papers in the dominant paradigm have attracted over sixty six thousand citations, and that number continues to grow.

The dominant paradigm is a hugely concentrated bet by the IS discipline on a small set of topics. It is a gamble that increasing the 'acceptance' of technologies such as cloud computing, mobile, social, or big data is a critical topic for the future. This concentrated bet has been recognized in criticisms that the theories underlying the 'IS acceptance' paradigm have become "an end in itself" (Benbasat and Barki, 2007; p. 216), becoming more of a mechanism for getting research published than addressing important questions in the world (e.g., Bagozzi, 2007). This paper provides a new set of empirical evidence for this debate.

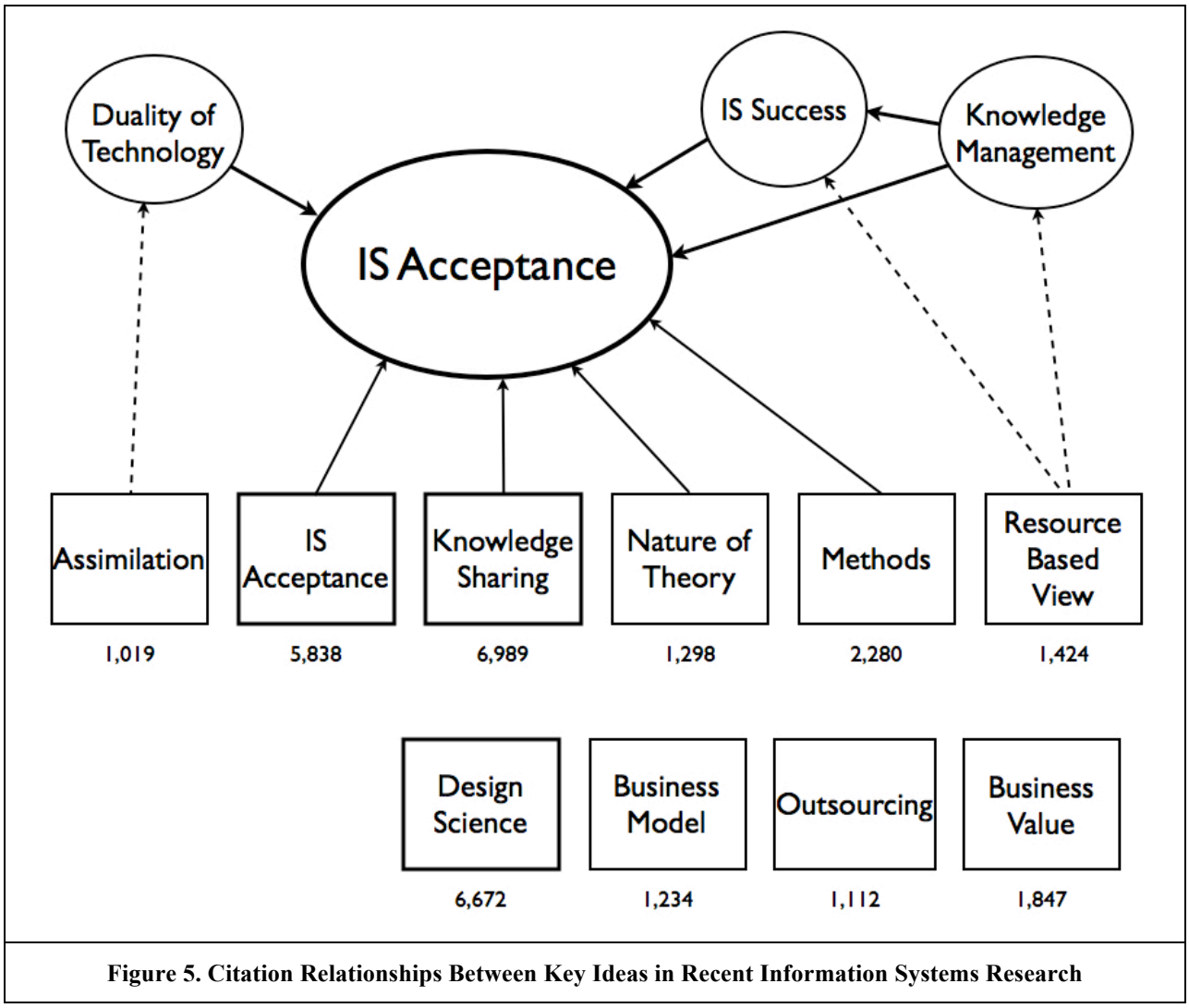

Figure 5. Citation Relationships Between Key Ideas in Recent Information Systems Research

Figure 5 is a further abstraction of the visualization in figure 4, showing the main topic areas and their relationship to the dominant paradigm of 'IS acceptance'. Solid arrows indicate a direct citation relationship between the most impactful papers in those topic areas, while dashed arrows indicate a citation relationship to a topic area that, in turn, cites the most impactful papers in the dominant paradigm. The dashed arrows therefore represent a more indirect relationship to the dominant paradigm. The numbers represent the total number of citations for the most impactful papers in each of the newer topic areas.

If we consider the highest impact research outside of the dominant paradigm, both the 'design science' and 'knowledge sharing' topics have successfully attracted an academic following. A proposal might be to summarize these topics as the single word concepts *design* and *expertise*. The topic areas of 'business model', 'business value', and 'resource based view' could be brought together under a single label of *strategy*. The highest impact topics outside of the dominant paradigm might be summarized as the concepts of design, strategy, and expertise in the context of information systems.

Conclusion and Limitations

The use of a community structure algorithm on a citation network of top papers is a novel contribution to the intellectual structure of the IS discipline, and one which has some advantages. It is a relatively transparent method that provides a visual interpretation of the intellectual history of a discipline. The

method could be used in other disciplines that are well represented in the Google Scholar database (Harzing, 2013), or in specialized sub-fields of the IS discipline, to quickly provide a baseline for understanding key topics and their interrelationships.

The main limitations of this work stem from the novelty of the analytic method. The analysis has not been based on other examples of the use of community structure algorithms to understand citation networks. This increases the risk that the analytic technique is being used in an incorrect or inappropriate way. There are many steps in network analysis that require interpretation and judgment, specifically in the way that topic areas are labelled, and to some degree aggregated. The best defense against both of these limitations is to be as transparent as possible, using data from a widely available source, and by presenting a step-by-step detailed tracing of the method (for example, the progression from figures 1 and 3, to figures 2 and 4, to figure 5, and finally to the proposed definition). That way, even if readers disagree on matters of interpretation, they will still have useful resources at their disposal to create their own.

References

Bagozzi, R. P. 2007. "The Legacy of the Technology Acceptance Model and a Proposal for a Paradigm Shift," *Journal of the Association for Information Systems* (8:4), pp. 243-254.

Banville, C., and Landry, M. 1989. "Can the Field of MIS be Disciplined?," *Communications of the ACM*, (32:1), pp. 48-60.

Benbasat, I., and Barki, H. 2007. "Quo Vadis TAM?," *Journal of the Association for Information Systems*, (8:4), pp. 211-218.

Benbasat, I., and Weber, R. 1996. "Research Commentary: Rethinking "Diversity" in Information Systems Research," *Information Systems Research* (7:4), pp. 389-399.

Benbasat, I., and Zmud, R. W. 2003. "The Identity Crisis within the IS Discipline: Defining and Communicating the Discipline's Core Properties," *MIS Quarterly* (27:2), pp. 183-194.

Clauset, A., Shalizi, C. R., and Newman, M. E. 2009. "Power-Law Distributions in Empirical Data," *SIAM Review* (51:4), pp. 661-703.

Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., and Pappas, G. 2008. "Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and Weaknesses," *The FASEB Journal* (22:2), pp. 338-342.

Galliers, R. D. 2003. "Change as Crisis or Growth? Toward a Trans-Disciplinary View of Information Systems as a Field of Study: A Response to Benbasat and Zmud's Call for Returning to the IT Artifact," *Journal of the Association for Information Systems* (4:1), pp. 337-351.

gephi.org. 2014. "Girvan Newman Clustering." https://marketplace.gephi.org/plugin/girvan-newman-clustering/, accessed November 14, 2014.

Harzing, A. W. 2013. "A Preliminary Test of Google Scholar as a Source for Citation Data: A Longitudinal Study of Nobel Prize Winners," *Scientometrics* (94:3), pp. 1057-1075.

King, J. L., and Lyytinen, K. (Eds.). 2006. *Information systems: The state of the field*, Chichester, UK: John Wiley & Sons.

Krcmar, H. 2014. "AIS President's Remarks." ICIS 2014 conference, Auckland, New Zealand.

Lyytinen, K., and King, J. L. 2004. Nothing at the Center?: Academic Legitimacy in the Information Systems Field," *Journal of the Association for Information Systems* (5:6), pp. 220-246.

Newman, M. E., and Girvan, M. 2004. "Finding and Evaluating Community Structure in Networks," *Physical Review E* (69:2), pp. 026113-127.

Orlikowski, W. J., and Baroudi, J. J. 1991. "Studying Information Technology in Organizations: Research Approaches and Assumptions," *Information Systems Research* (2:1), pp. 1-28.

Orlikowski, W. J., and Iacono, C. S. 2001. "Research Commentary: Desperately Seeking the "IT" in IT Research—A Call to Theorizing the IT Artifact," *Information Systems Research* (12:2), pp. 121-134.

Robey, D. 2003. "Identity, Legitimacy and the Dominant Research Paradigm: An Alternative Prescription for the IS Discipline: A Response to Benbasat and Zmud's Call for Returning to the IT Artifact," *Journal of the Association for Information Systems* (4:1), pp. 352-359.

Sidorova, A., Evangelopoulos, N., Valacich, J. S., and Ramakrishnan, T. 2008. "Uncovering the Intellectual Core of the Information Systems Discipline," *MIS Quarterly* (32:3), pp. 467-482.

Walsham, G. 2012. "Are We Making a Better World with ICTs? Reflections on a Future Agenda for the IS Field," *Journal of Information Technology* (27:2), pp. 87-93.

Weber, R. 2003. "Still Desperately Seeking the IT Artifact," *MIS Quarterly* (27:2), pp. iii-xi.

Zuboff, S. 2015. “Big Other: Surveillance Capitalism and the Prospects of an Information Civilization,” *Journal of Information Technology* (30:1), pp. 75-89.

Appendix A: Most Cited Papers in Information Systems

ID	Citations	Full Reference
D89	21152	Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319-340.
DBW89	11396	Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(8), 982-1003.
VMDD	9595	Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.
VD00	7175	Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186-204.
DM92	6968	DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research*, *3*(1), 60-95.
AL01	6782	Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, 107-136.
D93	6570	Davenport, T. H. (1993). *Process innovation: Reengineering work through information technology*. Harvard Business Press.
HMPR04	5623	Hevner, A. H., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, *28*(1), 75-105.
MB91	5122	Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, *2*(3), 192-222.
TT95	4816	Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*, *6*(2), 144-176.
DM03	4713	Delone, W. H. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems*, *19*(4), 9-30.
BGM87	3952	Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The case research strategy in studies of information systems. *MIS Quarterly*, 369-386.
O92	3765	Orlikowski, W. J. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science*, *3*(3), 398-427.
DS90	3632	Davenport, T. H., & Short, J. E. (1990). The new industrial engineering: Information technology and business process redesign. *Sloan Management Review*, *31*(4).
KM99	3552	Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, 67-93.
CH95	3547	Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, 189-211.

GKS03	3409	Gefen, D., Karahanna, E., & Straub, D. W. (2003). Trust and TAM in online shopping: an integrated model. *MIS Quarterly*, *27*(1), 51-90.
C98	3287	Chin, W. W. (1998). Issues and Opinion on Structural Equation Modeling. *MIS Quarterly*, *22*(1), 3.
HV93	3186	Henderson, J. C., & Venkatraman, N. (1993). Strategic alignment: Leveraging information technology for transforming organizations. *IBM Systems Journal*, *32*(1), 4-16.
O08	3032	Orlikowski, W. J. (2008). Using technology and constituting structures: A practice lens for studying technology in organizations. In *Resources, co-evolution and artifacts* (pp. 255-305). Springer London.

Table 1. The 20 Most Cited Papers in Information Systems

Appendix B: Most Cited Papers in Information Systems Since 2004

ID	Citations	Full Reference
HMPR04	5623	Hevner, A. H., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, *28*(1), 75-105.
O08	3032	Orlikowski, W. J. (2008). Using technology and constituting structures: A practice lens for studying technology in organizations. In *Resources, co-evolution and artifacts* (pp. 255-305). Springer London.
WF05	2503	Wasko, M. M., & Faraj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *MIS Quarterly*, 35-57.
BZKL05	1972	Bock, G. W., Zmud, R. W., Kim, Y. G., & Lee, J. N. (2005). Behavioral intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *MIS Quarterly*, 87-111.
MKG04	1847	Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Review: Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly*, *28*(2), 283-322.
WH04	1424	Wade, M., & Hulland, J. (2004). Review: the resource-based view and information systems research: Review, extension, and suggestions for future research. *MIS Quarterly*, *28*(1), 107-142.
KTW05	1376	Kankanhalli, A., Tan, B. C., & Wei, K. K. (2005). Contributing knowledge to electronic knowledge repositories: an empirical investigation. *MIS Quarterly*, 113-143.
vH04	1362	Van der Heijden, H. (2004). User acceptance of hedonic information systems. *MIS Quarterly*, 695-704.
G06	1298	Gregor, S. (2006). The nature of theory in information systems. *Mis Quarterly*, 611-642.
WT05	1249	Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research*, *16*(1), 85-102.
OPT05	1234	Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Clarifying business models: Origins, present, and future of the concept. *Communications of the Association for Information Systems*, *16*(1), 1.
GS05	1165	Gefen, D., & Straub, D. (2005). A practical guide to factorial validity using

		PLS-Graph: Tutorial and annotated example. *Communications of the Association for Information Systems*, *16*(1), 5.
CHW06	1138	Chiu, C. M., Hsu, M. H., & Wang, E. T. (2006). Understanding knowledge sharing in virtual communities: An integration of social capital and social cognitive theories. *Decision Support Systems*, *42*(3), 1872-1888.
PG04	1137	Pavlou, P. A., & Gefen, D. (2004). Building effective online marketplaces with institution-based trust. *Information Systems Research*, *15*(1), 37-59.
SBG04	1115	Straub, D., Boudreau, M. C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *The Communications of the Association for Information Systems*, *13*(1), 63.
DGHJ04	1112	Dibbern, J., Goles, T., Hirschheim, R., & Jayatilaka, B. (2004). Information systems outsourcing: a survey and analysis of the literature. *ACM SIGMIS Database*, *35*(4), 6-102.
PTRC07	1049	Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, *24*(3), 45-77.
PF06	1047	Pavlou, P. A., & Fygenson, M. (2006). Understanding and predicting electronic commerce adoption: An extension of the theory of planned behavior. *MIS Quarterly*, 115-143.
VB08	1043	Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, *39*(2), 273-315.
LSHX07	1019	Liang, H., Saraf, N., Hu, Q., & Xue, Y. (2007). Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management. *MIS Quarterly*, 59-87.

Table 2. The 20 Most Cited Papers in Information Systems, Published Since 2004