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Defining the intellectual structure of information systems and related college of business disciplines: a bibliometric analysis

Jean A. Pratt · Karina Hauser · Cassidy R. Sugimoto

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Abstract Information systems permeate every business function, thereby requiring holistic Information Systems (IS) approaches. Much academic research is still discipline specific. More interdisciplinary research is needed to inform both industry and academe. Interdisciplinary research has been positively associated with increased levels of innovation, productivity and impact. IS research contributes to the knowledge creation and innovation within IS and other College of Business (COB) disciplines. This research defines the intellectual structures within IS and between IS and other COB disciplines. We use a large scale, diachronic bibliometric analysis of COB journals to assess reciprocal knowledge exchange and also to identify potential intra- and interdisciplinary publication outlets. Our findings show an increase in IS knowledge contributions to other COB disciplines, which supports the discussion that IS is a reference discipline. Our research also visually depicts the intellectual structures within IS and between IS and other COB disciplines. Anyone exploring research in IS and allied COB disciplines can peruse the proximity maps to identify groups of similar journals. The findings from this research inform decisions related to which journals to read, target as publication outlets, and include on promotion and tenure lists.

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J. A. Pratt
Department of Information Systems, Schneider Social Science,
University of Wisconsin at Eau Claire, Room 411, Eau Claire, WI 54702, USA
e-mail: prattja@uwec.edu

K. Hauser
Management Information Systems, Utah State University,
3515 Old Main Hill, Logan, UT 84322, USA
e-mail: Karina.hauser@usu.edu

C. R. Sugimoto (✉)
School of Library and Information Science, Indiana University Bloomington,
1320 East 10th St., Bloomington, IN 47405, USA
e-mail: sugimoto@indiana.edu

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Introduction

An ongoing discussion in Information Systems (IS) revolves around whether IS is a contributing or reference discipline (Gill and Bhattacherjee 2009; Grover et al. 2006a, b; Grover et al. 2009; Wade et al. 2006a, b). This study uses bibliometric research methods to discuss the IS discipline as part of the reciprocal, contributing knowledge network suggested by Baskerville and Myers (2002). Researchers use bibliometric research methods to map and examine knowledge networks at different levels of granularity in order to identify those articles, researchers, topics and journals that define a particular field as well as the connections among fields (Baskerville and Myers 2002; Small 1973; Taneja et al. 2009). We start from the premise that IS is an independent discipline as evidenced by its scholarly conferences, within-field citations, and distinct research streams (Baskerville and Myers 2002, 2009; Culnan and Swanson 1986; Grover et al. 2006a, b; Myers and Baskerville 2009). Since the role of IS in business is fully integrated within all business functions, we investigated the influence of IS on other College of Business (COB) disciplines. Our focus on COB disciplines differs from previous research investigating the influence of IS on other disciplines, some of which are outside the COB (Grover et al. 2006a; Polites and Watson 2009).

Our first research objective is to identify the reciprocal impact of scholarly contributions between IS and other COB disciplines. We apply and extend field co-citation analysis (Sugimoto et al. 2008) using COB fields. Discipline-defining journal sets were used as proxies of the COB disciplines. We describe the volume of IS and other COB discipline influence as manifested through mutual citations. We also identify the trend of IS influence on COB disciplines over the past four decades.

Reciprocal knowledge flow indicates interdisciplinarity, which is aligned with the integrative problem-solving approach taken by business. Businesses have transitioned away from focusing on single, departmental functions to a business process orientation that focuses on the complete value stream and tightly integrates the different business functions. This transition resulted in significant improvements in financial and non-financial performance (McCormack and Johnson 2001; Skrinjar et al. 2008). Researchers in the business disciplines (e.g., Anonymous 2007; Di Meglio 2007) are often criticized for their research not being relevant to practitioners. To better align research with business practices, COB researchers need to look beyond departmental boundaries and integrate different business disciplines. The need for business alignment is especially important for IS researchers, since information systems are the people, procedures, technology and data that integrate all the other departmental functions.

Most business issues are complex and involve more than one business function and therefore require either an inter-, multi- or trans-disciplinary approach. For the purpose of our paper, we define interdisciplinary research as any research that integrates knowledge from more than one discipline. For definitions and distinctions of the terms interdisciplinary, multidisciplinary and transdisciplinary, see (Balsiger 2004). Several researchers have encouraged interdisciplinary research as a means of informing both industry and academe while further developing IS as a reference discipline (Baskerville and Myers 2002, 2009; Gill and Bhattacherjee 2009). Interdisciplinary research guiding business

practice is a solution with accompanying benefits to both the discipline and the IS researcher. For example, collaborative co-authorship with researchers in allied disciplines results in creative, innovative ideas that advance both disciplines (Oh et al. 2005); researchers assuming a boundary-spanning role in loosely coupled research networks gain more knowledge capital that transfers to an increase in academic impact (Oh et al. 2005); and the highest impact factors are associated with articles containing 20–40% of citations to journals in other disciplines (Lariviere and Gingras 2009). A way to identify journals most likely to publish interdisciplinary research is needed.

Our second research objective is to identify the intellectual structure both within IS and between IS and other COB disciplines. We extend previous IS network analysis research (Biehl et al. 2006; Nerur et al. 2005; Polites and Watson 2009) in the following ways. First, we define each cluster of journals based on published journal topic areas and previous research rather than general discipline categories. Second, we visualize each IS/COB discipline pair using two-dimensional proximity maps to reveal relationships among the journal clusters constituting the intellectual structure. Additionally, we identify which journals are boundary-spanners, as indicated by their loading on multiple clusters. Visualizing this intellectual structure helps researchers identify suitable journals within broad research areas in IS and between IS and other COB disciplines.

Methods

Discipline selection

To determine which disciplines to include in our study, we considered both COB program offerings and previous research defining the IS discipline. Early bibliometric research (Culnan and Swanson 1986) focused on the three foundational disciplines of IS: Management Science, Computer Science and Organization Science. The focus of the current research was the reciprocal impact between IS and other COB disciplines, so Computer Science was omitted from this study. Organization Science is generally taught as a subset of Management so was therefore included within Management. More recent research (Grover et al. 2006a; Wade et al. 2006a, b) acknowledged knowledge transfer between IS and other disciplines by extending the scope of analysis to include other business management disciplines. Grover et al. (2006a) added Marketing and Economics to the Culnan and Swanson list. Wade et al. (2006a, b) used the Financial Times list of high-quality journals to categorize the disciplines they used: Accounting, Economics, Entrepreneurship, Ethics, Finance, General Management, International Business, IS, Marketing, Management Science, Management Review, Management Strategy and Organizational Behavior.

Keeping in mind the tighter integration of IS with COB sub-disciplines compared to supra-disciplines (Grover et al. 2006b), both established (e.g., Management) and emerging (e.g., Entrepreneurship) disciplines were included. Economics was omitted since (a) prior research (Grover et al. 2006a; Wade et al. 2006a, b) indicated minimal impact on IS and (b) Economics is sometimes located outside the COB. Technology Innovation Management, Human Resource Management and Productions Operation Management either shared most of the same journals with Management or lacked sufficient journal rankings; they were therefore merged with Management in our study. Finance and Accounting were assessed separately based upon sufficient quantity of ranked journals to represent each discipline independently. The six disciplines included in this study were Accounting, Entrepreneurship, Finance, Information Systems, Management, and Marketing.

Journal selection

Journals are an excellent proxy for fields because of their continuity and stability over time coupled with their simultaneous ability to include diverse and evolving research themes and methodologies. Selection of journals to define a field is important. Co-citation analysis results can vary significantly based on the selection of journals (Chua et al. 2002). Although use of the Journal Citation Report ranked list of journals was considered, we chose not to use that list because (a) no clear categories exist for all of the selected business disciplines and (b) the Impact Factor is based on citation data only and therefore produces an incomplete ranking based on our need for both scholarly and practitioner-oriented business journals. Instead, forty-two journal-ranking studies were used to generate a list of ranked journals per discipline (see online supplements). This large sampling of ranking studies enabled us to include both perception- and citation-based journal rankings. Use of both ranking methods offset the weakness inherent in each. Perception-based ranking is subject to bias: respondents rank journals they know, thereby creating a predominant research community that continues the cycle of citing/recommending a set of journals to the exclusion of journals representing niche research communities (Chua et al. 2002). Citation-based journal ranking is impacted by perception-based journal ranking in that researchers tend to cite those journals they perceive as more relevant to their research. Additionally, citation-based ranking favors journals published in English, more established journals, and journals containing review articles (Chua et al. 2002). For our purposes, the actual ranking of each journal was not as important as identifying a select group of active journals representing a work point (the discipline represented by the journal). Therefore, we followed a method described by Rainer and Miller (2005) to combine average and re-rank journals within each discipline.

Advances in bibliometric research technology enables analysis of larger data sets than heretofore possible. Whereas previous research was limited to 35 or less journals representing work points, the current research employed 25 ranked journals for each discipline. Multiple disciplines shared some journals in their ranked journal studies; therefore, our final data set was comprised of 115 unique journal titles. A set of 25 journals per discipline captures both the core and the diversity of each discipline and identifies quality journals facilitating collaborative interdisciplinary research. Additionally, a total of 25 journals per discipline communicates well as visual information retrieval interfaces and are sufficient to represent invisible colleges (White 2003). See the online supplements for a list of the journal titles by discipline.

Database selection

DIALOG OneSearch was used to perform cited-reference searches in the Thomson Reuters Web of Knowledge (formerly ISI Web of Knowledge). The Social Science, Science, and Arts & Humanities databases were selected because of their broad coverage of disciplines, the volume of publications within each discipline (Meho and Sugimoto 2009), and the ability to constrain searches to research articles and review articles only. The Scopus database (which also contains books and conference proceedings) has been suggested as a citation source for determining scholarly impact, albeit only from 1995 forward. The additional business journals included in the Scopus database were of marginal overall importance to the field (Levine-Clark and Gil 2009), further confirming the use of the ISI databases for this research. Likewise, many business-discipline journals are indexed in

ABI/INFORM; however, ABI/INFORM does not index the cited references in a way that makes them accessible for a search. Journals that were listed in our aggregated top-25 ranking per discipline but were not indexed in the ISI databases were removed from analysis and replaced by the next-ranked journals. The final list of journals was comprised of 83% of the original 25 journals per discipline, providing confidence in discipline coverage using the ISI databases.

Citation and co-citation analysis

The focus of this research was on the paired relationships between IS and each other COB discipline. Citation analysis was used to identify the impact between IS and each other COB discipline (the degree to which each discipline cited and was cited by another); co-citation analysis was used to visualize intradisciplinary and interdisciplinary spatial relationships. The premise underlying co-citation analysis is that the more two documents are cited together, the more similar they are. Co-citation analysis was pioneered by Small (1973) who utilized co-cited documents to visualize "invisible colleges" (Price and Beaver 1996). This technique was expanded to include authors (White and Griffith 1981), journals (McCain 1991), and fields (Sugimoto et al. 2008). In each of these manifestations, aggregates of the documents serve as proxies for the variable under study. For example, in author co-citation analysis, the author is comprised of all of the documents he/she has written; in field co-citation analysis, the field is comprised of all articles written in the journals that define a given field. This study employs field co-citation analysis: each field is defined by a set of journals identified by members of that field. The fields are co-cited when any article cites both fields, as manifested through the journals comprising each field. The following procedure was executed; the tools are provided in parentheses. Detailed descriptions follow.

1. Identify the total number of publications for each discipline within the given time frame (DIALOG)
2. Identify the total times each discipline cited another discipline (DIALOG)
3. Identify the total times each journal within a discipline cited any other COB discipline journal (DIALOG)
4. Create a symmetrical co-citation matrix in which all journals are listed in the rows and columns and the cells represent the number of times those two journals were co-cited (Excel)
5. Run multidimensional scaling on the raw co-citation matrix to create a two-dimensional mapping of the journals for each discipline pair (PROXSCAL in SPSS)
6. Run principal components analysis on the co-citation matrix to create a varimax rotated component matrix for each discipline pair (FACTOR in SPSS)
7. Identify clusters of similar journals using the output from the multidimensional scaling and rotated component matrix

While acknowledged limitations of citation analysis have been discussed (see Meho and Sonnenwald (2000) for a list of bibliometric validation studies), bibliometric research methods have been validated and used in IS research both to debate the status of IS as a discipline or a referential/contributing discipline (Grover et al. 2006a; Wade et al. 2006a, b) and to examine whether IS research trends/fashions lead or follow practitioner interests in the same topics (Baskerville and Myers 2009).

Reciprocal impact methods

Reciprocal impact is determined by identifying articles in journals from a given COB discipline which cited an IS journal and vice versa. Since any journal will contain self-citations, including the same journal in both disciplines evaluated by the co-citation analysis would dilute the results. The journals representing the flow of knowledge transfer between any two disciplines must be distinct and unique. Therefore, we removed from the different COB disciplines those journals ranked by two or more COB disciplines and grouped them into a "Shared" category for the reciprocal impact portion of this research.

The actual process of deriving the interdisciplinary reciprocal impact via DIALOG required three steps. The first step identified the total number of articles published by each COB discipline (treating the "Shared" journals as a separate discipline). We ran DIALOG searches for all publications originating from each unique set of discipline-defining journals. We constrained the searches to research and review articles with fully indexed cited-references fields. Review articles were included because they "synthesize the paradigmatic core of concepts and predominantly shared assumptions whereby the state of the art in a particular subject area is established" (De Bellis 2009, p. 34)

The second step identified the total number of citations to each COB discipline from any journal indexed in the ISI databases regardless of what year the paper being cited was published. We ran DIALOG cited-works searches for all citations to each unique set of discipline-defining journals. The third step combined the search strings from Steps 1 and 2 to produce the quantity of citations from articles in IS to each comparative COB discipline and the quantity of citations from articles in each COB discipline to IS. We tracked trends in citations by calculating the total citations from 1969 to 2008 and then segmented the citations by decade. This is the largest COB bibliometric analysis to date in terms of quantity of journals and length of time.

The DIALOG search process produced two outputs: (1) the total number of articles produced by each discipline; (2) the number of times IS cited each discipline and vice versa. From this, the percentage of overall IS citations to each of the other COB disciplines and the percentage of other COB discipline citations to IS were used to indicate the reciprocal impact between IS and the other COB disciplines.

Multidimensional scaling

MDS was used to visualize the relationships among journals. Multiple raw-data, similarity proximity matrices were developed. Each matrix was symmetrical, with the rows and columns comprised of identically ordered journals representing IS and one other COB discipline (e.g., IS and Accounting in one matrix; IS and Management in another, etc.). Cell values represented the count of articles, indexed in the ISI databases, that cited the paired journals. Higher cell numbers represent a greater degree of similarity between the paired journals. In multivariate analysis all variables (journals) are treated the same: no distinction exists between disciplines in the input variables. Journals ranked (shared) by both IS and the comparative COB discipline were included only once in the multivariate analysis and were highlighted as "shared" in the output.

Use of the Pearson correlation on a symmetrical proximity matrix distorts the results (Leydesdorff and Vaughan 2006). Furthermore, SPSS provides a PROXSCAL (proximity scale) option for use with symmetrical matrices. Therefore, we imported the raw frequency counts from the symmetrical matrices directly into SPSS. The resulting proximity maps illustrate the intellectual structures represented by groups of journals: the higher the

similarity between journals, the closer the two journals will be located to each other on the proximity map relative to the other journals from the two disciplines.

A major purpose of multidimensional scaling is to reduce the multidimensional space of the original data to only two or three dimensions (McCain 1990). The resulting "flattening" of the data makes the data easier to interpret but necessarily distorts the original data in the process. We used Kruskal's stress measure (Leydesdorff and Vaughan 2006; McCain 1990) to determine goodness of fit for the multidimensional scaling analysis.

Principal component analysis (PCA)

We used PCA to identify journal clusters (see the online supplements for PCA Tables 4–8). Two uses of PCA are to (a) determine empirically how many dimensions account for most of the variance in a relationship and (b) verify that the loadings used for cluster interpretation are significant. The PCA components correspond to the MDS clusters. Both statistical tests provide a level of confidence in cluster interpretation. PCA is an appropriate approach to exploratory factor analysis, since it reduces a large number of variables to combined sets of variables based on similar information, while retaining as much of the original information as possible. An advantage of principal component analysis is that journals can load on more than one component, thereby giving additional information about boundary-spanning journals.

To counter the known possibility of increased standard errors on component loadings, we employed a conservative approach of doubling the minimum critical value (CV) necessary for significance and setting alpha at 0.01 (Stevens 1996). Given the number of variables per PCA ($N \sim 50$), we set the CV to 0.722; that is, although all variables (journals) are displayed in the rotated component matrix, only those variables with a CV of 0.722 or higher were used to interpret the component (cluster). We also followed the accepted practice of either requiring four or more variables loading at a minimum 0.60 each to create a viable component for interpretation or at least three variables with loadings above 0.80 (Stevens 1996). The varimax rotated component matrix displays the resulting components.

Citation threshold

We used an averaged citation threshold on all multivariate analyses to ensure that runts or other exceptions did not distort the visual output. No clear guideline exists for establishing an acceptable citation threshold. Both a 0.0081 below average (Polites and Watson 2009) and a 0.10 above average (Biehl et al. 2006) citation threshold have been used in previous research. A 0.05 below average citation threshold was used. The following journals were removed from the multivariate statistical analyses based on the 0.05 citation threshold:

- Accounting: *Accounting and Business Research*, *National Tax Journal*, *Journal of Taxation* and *Taxes*
- IS: *Knowledge-Based Systems* and *Journal of Database Management*
- Management*: Gender, Work and Organization*; *Journal of General Management.* The Law Review Journals (Columbia, Harvard, Stanford and Yale) were also removed, since they cited mainly themselves and did not interact with Management or IS
- Marketing: *Australian Journal of Management*

Additionally, journals that ceased publication were relevant for the historical import/export analysis, but were irrelevant to the analysis of the current state of interdisciplinary

research; therefore, the following journals were also removed prior to performing the spatial analyses:

- *Journal of Systems Management*
- *Journal of Business*
- *Enterprise and Innovation Management Studies*
- *Entrepreneurship, Innovation and Change*
- *Administrative Management*
- *Data Base*

Results

Reciprocal impact results

The total number of papers analyzed was 148,009. The number of papers varied considerably among the disciplines: Accounting had the least number of published papers with 8,913 (6.02%), and the Shared journals had the highest number of papers with 37,091 (25.06%).

The Information Systems discipline continues to reference other business disciplines, with the greatest source of references coming from the shared journal group, which included core business journals such as *Management Science (MgmtS)*, *Harvard Business Review (HBR)*, *Academy of Management Journal (AMJ)*, and *Administrative Science Quarterly (ASQ)*. Table 1 identifies the number and percentages of IS articles citing at least one of the top-ranked journals from another business discipline. For example, out of the 15,469 IS articles we analyzed, 3,554 (22.97%) referenced at least one of the top-ranked Accounting journals. Table 2 identifies the number and percentages of articles in the top-ranked business journals that cited at least one IS journal. For example, out of the 8,913

Table 1 Citation import to IS

IS	Acctg	Shared	Entrep	Fin	Mgmnt	Mktg
Number (IS = 15,469)	3,554	4,453	1,479	1,054	3,044	1,481
Percent	22.97	28.79	9.56	6.81	19.68	9.57

Table 2 Citation export from IS

Discipline	Total articles per COB discipline from 1969–2008	Number of COB-discipline articles citing information systems journals	Percent of COB-discipline articles citing information systems journals
Accounting	8,913	105	1.18
Shared	37,091	1,700	4.58
Entrepreneurship	15,060	711	4.72
Finance	30,196	60	0.2
Management	21,645	1,067	4.93
Marketing	19,635	337	1.72

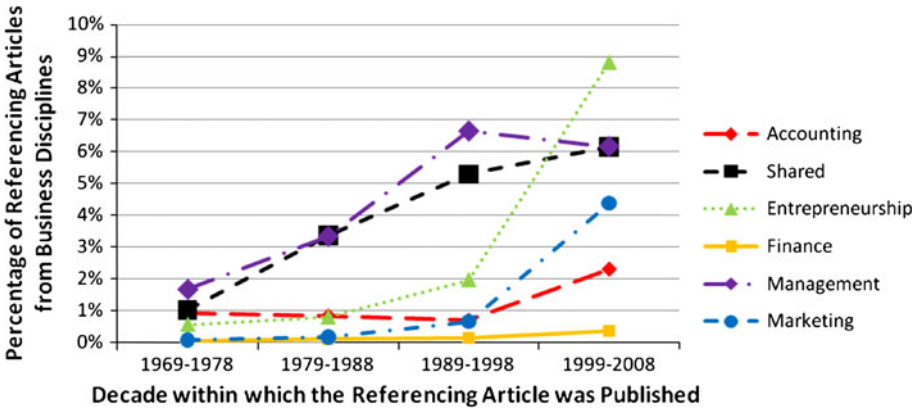

Fig. 1 Percentage of business disciplines referencing IS research from 1969–2008

Accounting articles we analyzed, 105 (1.18%) referenced at least one of the top-ranked IS journals.

Table 2 illustrates the reciprocal knowledge exchange between IS and each other business discipline in percentages. IS serves as a contributing discipline to other business disciplines. All business disciplines reference IS research to some extent—from 0.2% to almost 5%. As indicated in Fig. 1, the percentage of business articles referencing information systems research has increased over the past four decades. The well-established Management discipline demonstrated a steady increase in quantity of citations to IS journals. Entrepreneurship and Marketing both demonstrated dramatic increases in IS references in the past decade.

Spatial relationship results

We performed multivariate analyses for each pair of IS/COB disciplines. Journals ranked by multiple disciplines are denoted with black circles in the MDS statistical analyses. This section begins with a discussion regarding the reliability of output from the MDS and PCA analyses as demonstrated by overall goodness-of-fit and variance statistics. We proceed to examine the IS clusters, which are similar on each of the IS/COB proximity maps. We then provide separate results for each pairing.

Goodness-of-fit data

Table 3 provides the goodness-of-fit data for the MDS (PROXSCAL) and the PCA analyses. The proximity maps produced from the MDS analyses provide good, two-dimensional representations of the similarity matrix input data, as demonstrated from the high dispersion-accounted-for (DAF) values and an acceptable Kruskal's Stress 1 values. A stress value of less than 0.2 is acceptable (McCain 1990). Each IS/COB interdisciplinary relationship was defined by five components/clusters (six for IS/Management), which explained between 86 and 88% of the variance in the relationships. A 75% variance threshold is generally accepted (Stevens 1996); therefore, the strong R squares provide confidence in the reliability of the clusters to define the IS/COB interdisciplinary relationships.

Table 3 Goodness-of-fit statistics for IS/COB inter-field relationships

	PROXSCAL		PCA	
	DAF	Stress-1	# of comp.	Cum. RSQ
Accounting	0.9692	0.1756	5	87.712
Entrepreneurship	0.9722	0.1666	5	85.972
Finance	0.9717	0.1684	5	87.745
Management	0.9625	0.1936	6	86.790
Marketing	0.9677	0.1797	5	87.170

Cluster definition

A predominant goal for this research was to provide researchers and practitioners with a guide to journals that could serve as publication outlets and sources of information. We used a corroborative approach to defining each cluster. First, we analyzed the scope and mission statement of each journal to derive initial cluster definitions. We then compared our cluster definitions with definitions culminating from prior field-defining studies for each discipline (Chua et al. 2002; Grover et al. 2006a; Nerur et al. 2005; Polites and Watson 2009; Wade et al. 2006a, b). Labeling and interpretation of clusters relies in part on some type of qualitative confirmation (De Bellis 2009; McCain 1990). Experts from each discipline confirmed our final cluster definitions. Our cluster definitions combine prior research with current journal definitions, thereby confirming and extending prior research.

Journals clustered closer together relative to other journals in the proximity maps are usually similar in terms of general research areas and methodologies. Journals in the intersections of overlapping clusters cross-loaded on two or more factors, indicating areas of commonality (Taylor et al. 2010). Of most interest to this research are those journals that appear in the overlap between disciplines, thereby suggesting potential for interdisciplinary research. Our study highlights sets of relevant, related journals, some of which they might not have previously considered for their research production or consumption.

The axes in proximity maps serve as reference points for discussion (Borg and Lingoes 1987; Kruskal and Wish 1978). Of most interest to this research is the proximal location of discipline-defining journals on the IS or the comparative COB discipline side of the *Y* axis. A separate cluster of management-oriented journals positioned on the IS side of the *Y* axis would indicate a primary IS perspective (e.g., managing the implementation of an enterprise resource planning system). A merged cluster with the constituent journals located on the comparative COB discipline side of the *Y* axis would indicate a secondary IS perspective (e.g., discussing Internet marketing and the related IS infrastructure). Within-discipline journal positioning along an axis is generally related to differences in methodology (qualitative/quantitative) or content (theoretical/applied).

Information Systems

Previous studies have used bibliometric methods to map the intellectual structure of IS (Chua et al. 2002; Grover et al. 2006a; Nerur et al. 2005; Polites and Watson 2009; Wade et al. 2006a, b). Whereas the purpose of previous studies was to define IS as a discipline, our research started with the premise that IS is indeed a distinct discipline, existing primarily in colleges of business. The purpose of this component of our research is to define the intellectual structure of IS relative to other College of Business disciplines. By focusing

especially on the proximal relationships between IS journals and journals from other COB disciplines, we identify possible intra- and interdisciplinary publication outlets. No other research has filled this gap in the literature.

IS emerged primarily as two discipline-defining clusters labeled Systems Technology and Socio-Technical Information Systems (see, for example, Fig. 2). The Systems Technology and Socio-Technical Information Systems clusters were consistently comprised of the same journals and together accounted for about 35% of the overall variance in each IS/COB discipline relationship. These two clusters illustrate the distinctiveness of IS in comparison to other COB disciplines. The statistically significant loadings onto the IS-journal components indicate a strong shared variance among variables (Table 4, Supplementary material); therefore, we have confidence in using the grouped journals to interpret the clusters on the proximity map (Fig. 2).

Journals in the Systems Technology cluster have a strong association with non-COB allied disciplines: Computer Science and Library and Information Science. The Systems Technology cluster represented, on average, about 10% of the overall variance in each IS/COB discipline relationship. IS journals that included articles more associated with Computer Science emerged near or above the *X* axis, indicating more alignment with technical than behavioral perspectives.

Journals in the Socio-Technical Information Systems cluster are associated with other IS journals and with allied COB disciplines (primarily Management). The dense clustering of the core IS journals near the management-oriented journals rather than the technologically-oriented journals indicates a discipline-defining shift. The shared commonality of a diverse set of research topics among the Socio-Technical Information Systems journals was demonstrated in an author co-citation analysis (Taylor et al. 2010). Whereas the IS

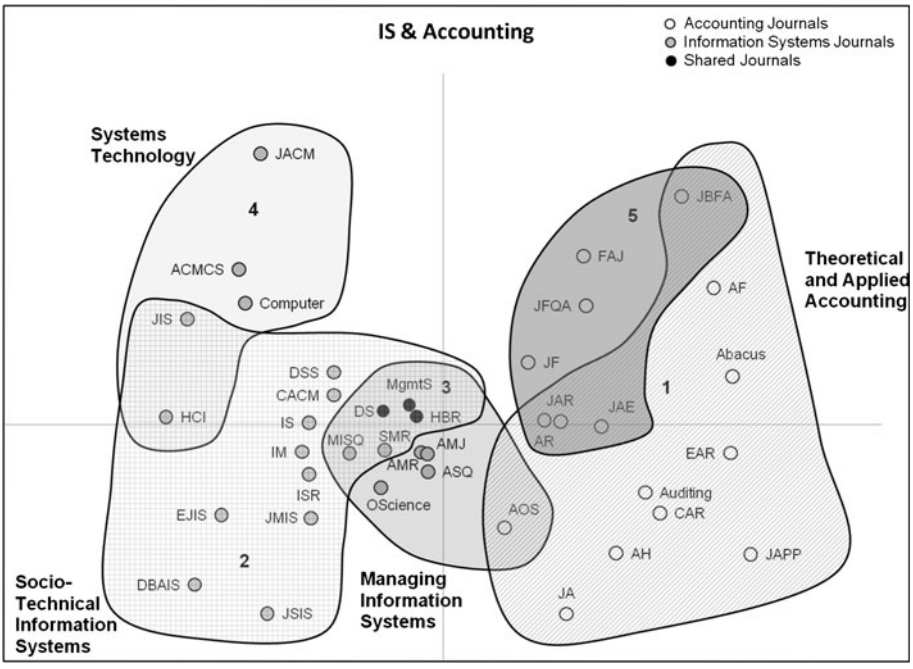

Fig. 2 IS/accounting proximity map

journals from that study loaded on multiple factors based on different research themes, those same journals all emerged in the Socio-Technical Information Systems cluster for this study.

Boundary-spanning journals emerge within two or more clusters. Journals that have an evenly distributed loading across components indicate balanced interdisciplinary research. That is, a journal that loads at 0.4 across three components indicates a similar volume of co-citations and commonalities with other journals in each of those components; whereas, a journal that loads at 0.9 on one component and 0.4 on another component would have more in common with journals from the first component than the second. To discuss the interdisciplinary journals that cross load on multiple components, we follow a precedent set by prior co-citation research (Taylor et al. 2010) to include journals that load at 0.4 or greater.

Human Computer Interaction (*HCI*) and *Journal of Information Science* (*JIS*) represent the primary intradisciplinary publication outlets within IS. Both journals loaded first on the Systems Technology component/cluster and then on the Socio-Technical Information Systems component/cluster, indicating technical/theoretical approaches to behavioral/applied issues. *HCI* divides its research into two categories: System Design—focused on system design and evaluation; User Science—focused on cognitive behavior and social impacts. The *JIS* editors stress the importance of theoretical articles informing practice and applied research being founded on theoretical principles. *HCI* and *JIS* emerged in the same cluster overlap on all the IS/COB proximity maps, albeit at somewhat different weights depending upon the influence of journals in the comparative COB discipline. In all instances, *JIS* has a more balanced loading distribution, indicating more equivalent distribution of intradisciplinary research between the two general research areas.

IS/Accounting

The rotated component matrix for IS/Accounting (Table 4, Supplementary material) shows that five components account for 87.71% of the variance in the IS/Accounting relationship. Components 1 and 2 represent the foundational Accounting and IS journals; they account for about 27 and 25%, respectively, of the overall variance in the interdisciplinary relationship. Component 3 (16.32%) is comprised of both IS journals and journals shared by both IS and Accounting. Components 4 (10.87%) and 5 (8.51%) represent niche research areas for both IS and Accounting.

An interdisciplinary cluster emerged in the IS/Accounting comparison and can be interpreted as Managing Information Systems. The Managing Information Systems cluster contains mostly leading management journals. The focus of the IS research in those journals is from a management perspective; hence, the focus on management in the cluster title. Results from this study confirmed previous studies (Chua et al. 2002; Polites and Watson 2009) which identified as target publications for IS some interdisciplinary journals closely related to other COB disciplines. IS and Accounting both list three management-oriented journals as top journals: *Decision Sciences (DS)*, *MgmtS* and *HBR*. However, the management-oriented journals are more aligned with IS than with Accounting, as indicated by their position to the left of the vertical axis (Fig. 2). *MgmtS* and *DS* have been used to represent a single work point associated with operations research (Grover et al. 2006a; Polites and Watson 2009), albeit *MgmtS* from a management perspective and *DS* from a more technical IS perspective. The remaining management journals in the Managing Information Systems cluster have been grouped and labeled previously as Management/Professional (Polites and Watson 2009) and subdivided into different management

emphases: General Management (*AMJ, Academy of Management Review* and *Organization Science*), Management Review (*HBR* and *Sloan Management Review*) and Organizational Behavior (*ASQ*) (Wade, Biehl, and Kim 2006a, b). Our label of Managing Information Systems captures the essence of those journals as related to IS research.

Five journals emerged in the overlap between the Socio-Technical Information Systems and the Managing Information Systems clusters, indicating an integration of IS and business management. The levels at which the journals cross-loaded on both components helps describe the emphasis placed on IS versus management. Both *MIS Quarterly* (*MISQ)* and *DS* loaded on the Socio-Technical Information Systems component/cluster at 0.73 with a weaker loading of 0.43 and 0.49 on the other component. Alternatively, *HBR*, *MgmtS*, and *Sloan Management Review* (*SMR*) all had stronger loadings on the Managing Information Systems component/cluster with weaker loadings on the Socio-Technical Information Systems component/cluster. These dissimilar loadings suggest that *MISQ* and *DS* might be better publication outlets for behavioral-oriented IS research with application for managers; whereas *HBR, MgmtS,* and *SMR* might be better publication outlets for research guiding the management of IS projects. *Accounting Organizations and Society* (*AOS*) was the only Accounting journal that cross-loaded on both IS and Accounting. The distributed cross loading of 0.66 and 0.69 indicates equivalent interdisciplinary co-citations.

Accounting is defined primarily by journals comprising the Theoretical and Applied Accounting cluster. Only *Financial Analysts Journal* and *Journal of Financial and Quantitative Analysis* loaded at a statistically significant level on Component 5 (see Table 4, Supplementary material), resulting in an insufficient number of journals for cluster interpretation.

Further examination of the Theoretical and Applied Accounting cluster and the corresponding rotated component matrix (Table 4, Supplementary material) illuminates positioning of the Accounting journals on the proximity map (Fig. 2). The more theoretically-oriented journals emerged above the *X* axis while the more practitioner-oriented journals emerged below the *X* axis. As indicated in Table 4 in Supplementary material, most of the journals in the Theoretical and Applied Accounting cluster loaded at 0.90 or higher. These discipline-defining journals are more applied and focus on educating both current and future researchers and practitioners. *Journal of Accountancy*, *Accounting Horizons* and *Journal of Accounting and Public Policy* are practitioner-oriented journals that target specific accounting emphases. They emerged near the bottom of the cluster and are perceived as practitioner oriented. *Journal of Accounting Research* (*JAR*)*, Accounting Review* (*AR*) and *Journal of Accounting and Economics* (*JAE*) publish more theoretical research and represent some of the top-tier journals in Accounting. Their acceptance rates are low; their content is comprised of mathematical, theoretical models. Although several journals in the Theoretical and Applied Accounting cluster include "Accounting Information Systems" in their list of suitable publication topics, they were proximally distant from the main Information Systems clusters.

Intradisciplinary publication outlets exist within Accounting. *JAR, AR*, *JAE* loaded from 0.73 to 0.78 on Component 1 (the Theoretical and Applied Accounting cluster) with a weaker loading of 0.4 to about 0.5 on Component 5, which is comprised of journals focused on financial economics. The scope and topics from these journals indicate a focus on financial accounting with some emphasis on economics. In contrast, *Journal of Business Finance Accounting* (*JFBA*) loaded at 0.7 on Component 5 with a fairly equivalent loading of 0.67 on Component 1. The editors of *JFBA* are explicit about the connection among finance, accounting and economics, thereby indicating a balance between financial accounting and financial economics.

Comparing the two disciplines, we note that the management-oriented journals are more aligned with the IS discipline than with Accounting. The positioning of those journals left of the vertical axis suggests a stronger emphasis on IS solutions to Accounting problems rather than a focus on the development of Accounting models using information systems. Also of note is the dense clustering of IS journals compared to the sparse clustering of journals defining Accounting. This finding might suggest that IS has a comparatively narrower discipline definition—with an emphasis on managing information systems—compared to the somewhat broader or more diverse emphases of Accounting.

IS/Entrepreneurship

Table 5 in Supplementary material shows that five components account for 85.97% of the variance in the IS/Entrepreneurship relationship. Comprised of 14 journals, the Management clusters (Fig. 3) exemplifies the field of Entrepreneurship. Its component accounts for 32.53% of the variance in the IS/Entrepreneurship relationship. Component 3 (the Entrepreneurship and Small Business Development cluster) contributes an additional 10.4%. Component 5 has insufficient statistically significant loadings to be interpreted reliably as a discipline-defining cluster. As discussed in "IS/Accounting," Components 2 and 4 represent the primary IS journals and together account for 37.41% of the variance in the relationship.

As an emerging discipline, Entrepreneurship is still enmeshed with and defined by its reference discipline Management. IS and Entrepreneurship share seven journals between their journal rankings*: AMJ, Academy of Management Review (AMR), ASQ, HBR, MgmtS, Organization Science* (*OScience*), and *SMR*. Five of the seven management-oriented

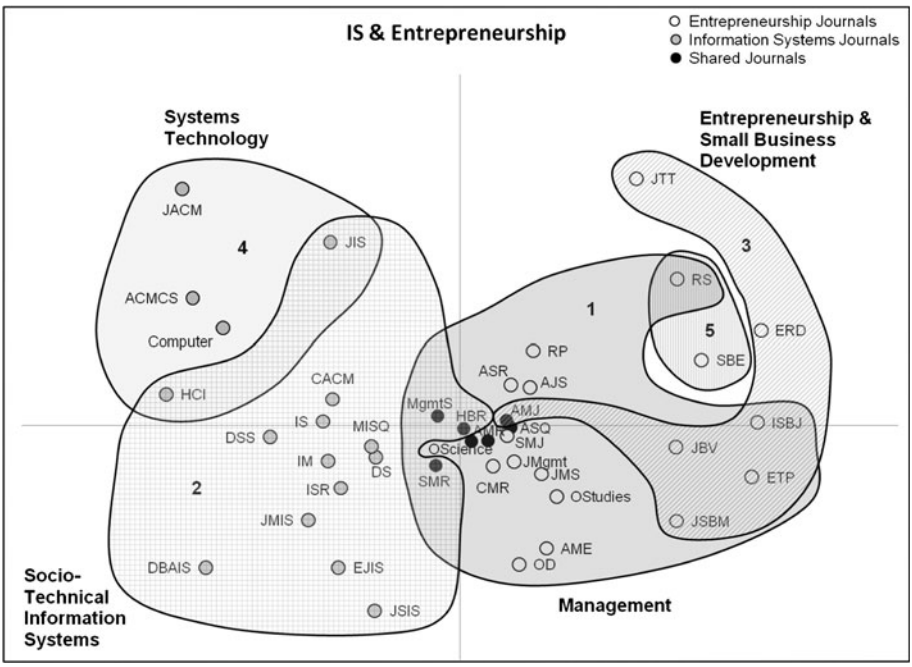

Fig. 3 IS/entrepreneurship proximity map

journals ranked by both IS and Entrepreneurship emerged on the Entrepreneurship side of the *Y* axis. The dense clustering of Entrepreneurship journals near the center of the proximity map indicates possible interdisciplinary publication outlets.

MgmtS, HBR and *SMR* emerged on the IS side of the *Y* axis and on the overlap between Socio-Technical Information Systems and Management, thereby suggesting a high level of interdisciplinarity between IS and Entrepreneurship. As they did in the IS/Accounting relationship, these three journals loaded first on the component containing the management-oriented journals and then on an IS component. The distribution of loadings between the two factors was somewhat more balanced in the IS/Entrepreneurship relationship than in the IS/Accounting relationship, due to the volume of co-citations from other journals in the Management cluster. That is, since Accounting was mostly independent of Management, the management-oriented journals all shared a greater variance with their cluster; the Management cluster had more journals contributing a share of the variance. Those journals addressing more general management issues grouped densely toward the center of the proximity map, while those journals addressing narrower management issues (e.g., sociological or entrepreneurial issues) emerged near the top and side of the cluster. Topics for most of the Management cluster journals are broad in nature—covering everything from advertising to technology. The scope statements for many of them indicate they are multidisciplinary; they emphasize empirical research to support managerial practice. Most of the journals in this cluster had rigorous acceptance rates of 15% or lower.

The interesting composition of journals in the Entrepreneurship and Small Business Development cluster underscores Entrepreneurship as a fledgling discipline. Of the seven journals comprising this cluster, *Journal of Business Venturing* (*JBV*) and *AMJ* loaded at the critical value on Component 1 and *Entrepreneurship and Regional Development* and *International Small Business Journal* (*ISBJ*) loaded at the critical value on Component 3. Thus, the Entrepreneurship and Small Business Development cluster is split between journals representing a narrower, niche foci of entrepreneurship and small business and the journals representing a general management perspective.

Intradisciplinary publication opportunities exist in *AMJ, JBV, Journal of Small Business Management, ISBJ* and *Entrepreneurship Theory and Practice* (*ETP*). A common theme running through these journals is their expressed welcome of pluralism in disciplines and methodological approaches applied to entrepreneurial phenomena. Many of these journals also list "technology innovation" as a suitable research topic.

IS/Finance

Five components account for 87.75% of the variance in the IS/Finance relationship. Each discipline contributed equivalently to the shared variance in the overall relationship, with the IS clusters accounting for 42.98% and the Finance clusters accounting for 44.78% of the variance (Table 6, Supplementary material). Almost all journals have a statistically significant shared variance with their corresponding component (Table 6, Supplementary material), further confirming the reliability of the IS/Finance clusters.

The weak IS/Finance interdisciplinary research indicated via the reciprocal analysis (Table 2, Supplementary material) was further confirmed by the MDS analysis (Fig. 4). IS and Finance have no shared journals and emerged as independent disciplines on each side of the *Y* axis. All management-oriented journals emerged on the IS side of the *Y* axis.

The interdisciplinary Managing Information Systems cluster again bridged IS and its allied COB discipline. *MgmtS* emerged as the sole interdisciplinary publication outlet between IS and Finance. *MgmtS* cross-loaded equivalently on the Financial Economics and

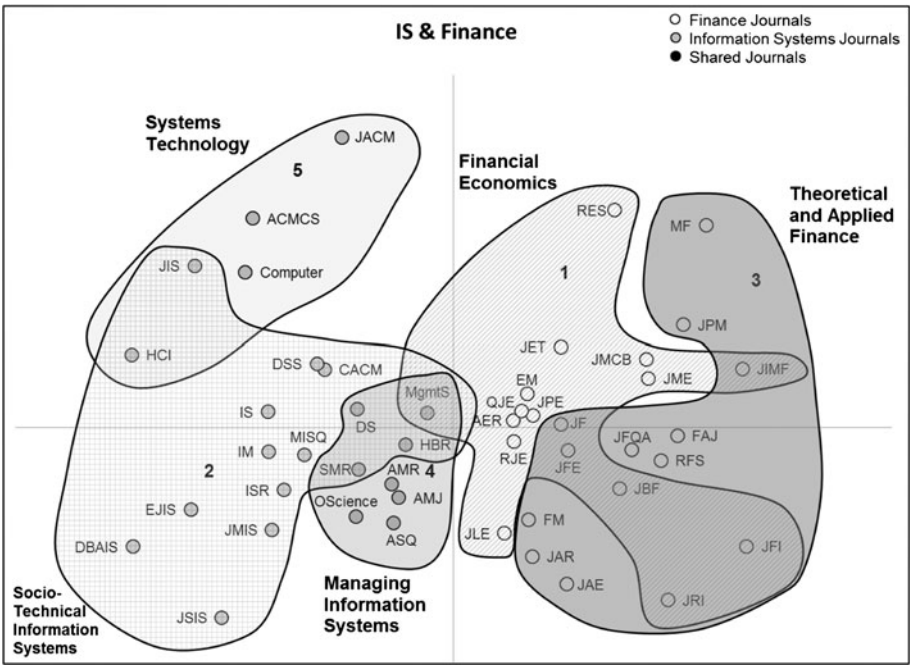

Fig. 4 IS/finance proximity map 2

Socio-Technical Information Systems cluster with a stronger loading on the Managing Information Systems cluster. This distribution of loadings illustrates the referential role that *MgmtS* serves with a focus on managerial issues from a multidisciplinary perspective.

Finance emerged clearly as two emphases: Financial Economics and Theoretical and Applied Finance (Fig. 4). The majority of journals in these two clusters loaded at 0.8 or higher, indicating strong, within-emphasis co-citation patterns. Most of the journals in the Financial Economics cluster are top-ranked economic journals, signifying the strong relationship between Finance and its allied discipline Economics. Most journals in both Finance clusters have rigorous acceptance rates of 10% or less. No parallel exists between location on the proximity map and acceptance rate. The positioning of journals above and below the *X* axis vary along the spectrum of mathematical models to applied research. A logical gateway between IS and Finance would be top journals. However, previous bibliometric research showed that *Journal of Finance* (*JF*), a top Finance journal, did not reference *Information Systems Research*, a top IS journal, even once (Wade et al. 2006a, b).

More intradisciplinary research opportunities exist within Finance than interdisciplinary research opportunities with IS. Intradisciplinary research opportunities within Finance are represented by six journals: *Journal of International Money and Finance, JF*, *Journal of Financial Economics, Journal of Banking Finance, Journal of Financial Intermediation* and *Journal of Risk and Insurance*. These six journals emerged in the overlap between the two Finance clusters and have in common a focus on empirical research driving practice. Keywords such as basic, case study, descriptive and applied in their scope statements coupled with identified users such as institutions and professionals indicate a relationship between academe and industry.

IS/Management

The IS/Management rotated component matrix explains 86.79% of the variance in the relationship and is divided into six components. The two IS Components 1 and 4 account for 37.59% of the variance. Whereas *AMJ, AMR, ASQ, HBR, MgmtS, OScience* and *SMR* formed the centrally located Managing Information Systems cluster in the IS/Finance and IS/Accounting proximity maps, that same group of journals loaded completely on Component 2 (Table 7, Supplementary material) and accounted for 25.20% of the variance. Understandably, most of those journals emerged on the Management side of the *Y* axis (Fig. 5), since they are commonly recognized as Management journals. Their high volume of citations positioned them proximally near the center of the proximity map.

Three journals (*AMJ, AMR, ASQ*) appeared in our list of top 25 IS and Management journals; all three are placed on the Management side of the *Y* axis. *DS*, *Journal of the Association for Computing Machinery* (*JACM*) and *SMR* loaded on both IS and Management components. With its focus on the latest computer technology, mathematical and statistical techniques used to inform decisions, *DS* loaded almost equivalently on both Components 1 and 5 and to a lesser degree on Component 2. The primary aim of *JACM* is to publish computer science research; however, the stated goal of "working at the boundaries" between computer science and other disciplines helps explain the positioning of *JACM* in the same cluster as operations research journals. *SMR* is published by the MIT Sloan School of Management at Harvard and represents a somewhat more technical perspective to strategic management practices than *HBR*, thereby explaining its position on the IS side of the *Y* axis. *HBR* and *Strategic Management Journal* (*SMJ*) emphasize

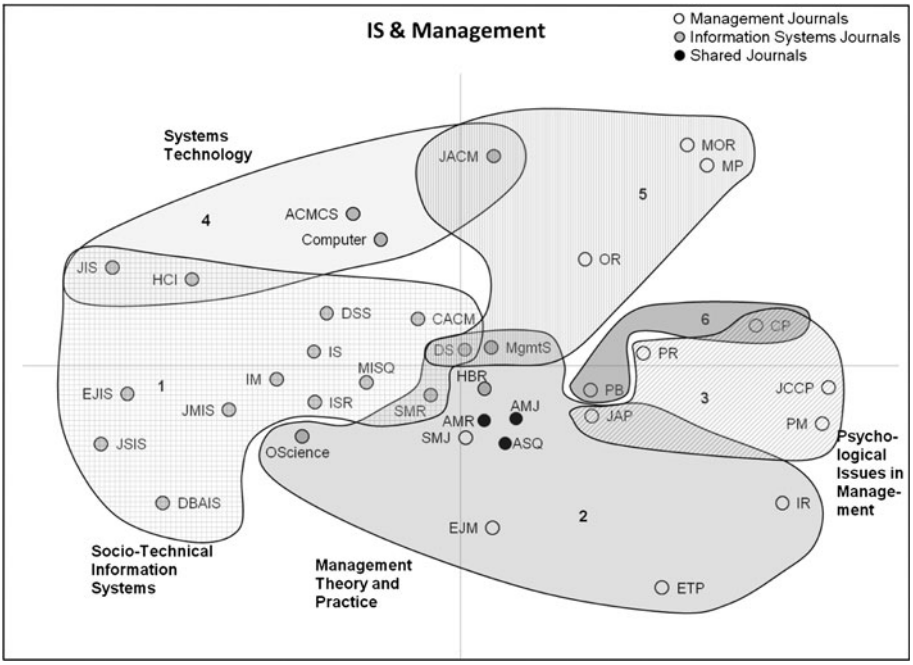

Fig. 5 IS/management proximity map

interdisciplinary research with a strong emphasis on empirical research providing practical results for managers.

OScience has an 83% shared variance with Component 2 (Table 7, Supplementary material); however, its solid positioning on the IS side of the *Y* axis and its closer proximity to IS journals than to Management journals indicate a strong association with IS. That is, *OScience* has a sufficiently large volume of co-citations with a few of the Management journals to load on the Management cluster, but the overall volume of co-citations with multiple IS journals pulled *OScience* away from the Management journals and closer to its co-cited IS journals. *DS, SMR* and *OScience* represent the most viable interdisciplinary publication outlets between IS and Management.

The Management journals loaded on four components, only two of which met the criteria for cluster interpretation. Management is defined by two emphases: Management Theory and Practice and Psychological Issues in Management. Component 2 (the Management Theory and Practice cluster) accounts for 25.20% of the overall variance in the IS/Management relationship; the other three Management clusters together comprise 24% of the variance (Table 7, Supplementary material). Most of the Management Theory and Practice cluster journals are located near the *Y* axis and include "multidisciplinary" or "interdisciplinary" in their scope statements. *MgmtS, HBR, AMR, SMJ* and *EJM* also are likely outlets for interdisciplinary research, since they are positioned close to the IS/Management boundary. The *European Journal of Marketing* (*EJM*), *ETP* and *Industrial Relations* each represent a more focused perspective of management and are therefore distanced somewhat from the other management journals.

Clusters 5 and 6 have too few statistically significant loadings to interpret with confidence (Table 7, Supplementary material). However, the journal titles comprising those clusters represent the mathematically oriented operations research area of management (Cluster 5) and psychology (Cluster 6). The close proximity of Cluster 6 to the Psychological Issues in Management cluster suggests a relationship, which is confirmed by some version of "psychology" in journal titles from both clusters. *Cognitive Psychology* emerged in the overlap between Cluster 6 and the Psychological Issues in Management cluster.

MgmtS, HBR and *SMR* are labeled as IS journals rather than as Management or "shared" journals. This seemingly contradictory labeling is an artifact of the varied emphases of the management journal-ranking articles. Whereas IS is a smaller, more defined discipline that consistently targets high-profile Management journals (Chua et al. 2002), Management is a much larger discipline with a diverse set of emphases. Some of the Management journal-ranking articles, which we used to derive our journal basket, emphasized a more focused selection of journals based on their niche area of research. However, regardless of how journals are originally categorized, they emerge in a discipline-defining cluster based on both the volume of co-citations and similarity of citation patterns with other journals. Thus, as we expected, most of these management-oriented journals emerged in a Management cluster.

MDS analysis results displayed in two dimensions converts the peaks and valleys of a co-citation landscape to a flat plain. However, three or more dimensions are difficult to portray and interpret in a static medium, so the limited two-dimensional view is preferable. An example of the limited two-dimensional view is illustrated via *MgmtS*. The PCA indicates that *MgmtS* might be on a different dimension than could be captured via a two-dimensional proximity map. The increased magnitude of citations to *MgmtS* compared with the other Management journals resulted in its having similar but non-significant loadings on Components 2 and 5, indicating about 23 and 17%, respectively, shared

variances with the other journals comprising those management components (Table 7, Supplementary material). Whereas *MgmtS* would be expected to load significantly on the primary management component, its high volume of citations in other disciplines results in a less-focused relationship with the management journals and a broader relationship with multiple disciplines. The cross loading of *MgmtS* on multiple components representing different COB disciplines is demonstrated in each IS/COB PCA analysis table.

IS/Marketing

Five clusters emerged from the IS/Marketing rotated component matrix (Table 8, Supplementary material), explaining 87.17% of the variance. Marketing is defined by three distinct influences: Management, Marketing Research and Psychology. As seen in other IS/COB discipline proximity maps, the Management cluster is comprised of generalist, more-cited journals grouped toward the center of the map with specialized, less-cited journals emerging at the periphery of the cluster.

Marketing and IS share six management-oriented journals in their lists of top journals: *AMJ, AMR, ASQ, HBR, MgmtS* and *SMR*. All but *MgmtS* emerged on the Marketing side of the *Y* axis (Fig. 6), indicating more co-citations with Marketing journals than with IS journals. The location of the management-oriented journals between IS and Marketing indicate a major gate-keeping role played by Management. Stronger IS/Marketing inter-disciplinary publication opportunities exist within *DS, MgmtS* and *SMR,* as indicated by the cross loading of those journals on both Components 1 and 2 (Table 8, Supplementary material). However, the distribution of the loadings varies among the journals. *DS* loaded first on Component 1 with a weaker loading on Component 2, whereas the opposite was

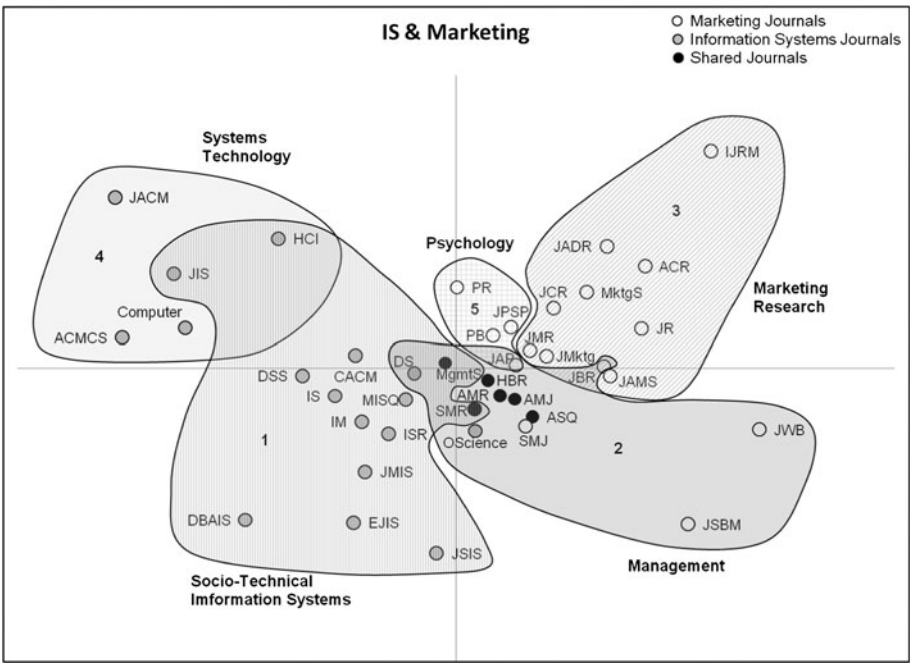

Fig. 6 IS/marketing proximity map

true with *MgmtS* and *SMR*. *MgmtS* and *SMR* loaded first on Component 2 with a weaker loading on Component 1. *DS* is aligned more with the IS journals and *MgmtS* and *SMR* are aligned more with the Marketing journals. The scope of these journals, as discussed in "IS/Management," helps to explain their co-citation patterns when compared to other journals within each discipline.

The list of publication topics for journals in the Marketing Research cluster are almost identical and usually include "technology innovation," suggesting that IS plays a secondary role in Marketing research. The mission statements of journals in the Marketing Research and Psychology clusters emphasize the practical contributions of theoretical research. The Psychology cluster journals clustered close to the center of the proximity map, indicating high levels of citations and common content both within their cluster and with the proximally located Management journals. All journals in the Psychology cluster include "organizational behavior" in their list of publication topics.

The *Journal of Applied Psychology* (*JAP*) and *Journal of Business Research* (*JBR*) represent intradisciplinary publication outlets for Marketing. *JAP* examines, among other things, psychological phenomena associated with individuals, groups, organizations and cultures across a variety of work settings. Different perspectives related to the influence of IS in the workplace falls into this area of research. The stated target for *JBR* research is "scholars and practitioners in the business field," indicating an academe-industry relationship. *JBR* lists IS as a suggested research topic and lists several areas to which IS could be applied.

Discussion

Reciprocal impact discussion

The debate regarding whether or not IS is a reference discipline has been widely discussed (Baskerville and Myers 2002; Grover et al. 2006a, b; Wade et al. 2006a, b). The current study utilized a far greater base of pertinent journals from relevant disciplines than previous research, thereby providing a more informed assessment regarding the status of IS as a reference discipline. Additionally, the 1969–2008 time period illustrates the growth of IS—diachronic data that was missing from previous studies. Findings from this research enable us to estimate the percentage of knowledge IS contributes to its allied COB disciplines.

Some researchers argue that since IS journals are not extensively cited by other COB researchers (Wade et al. 2006a, b) or because IS does not export an equivalent quantity of knowledge to its foundational reference disciplines (Polites and Watson 2009), then IS does not qualify as a reference discipline. We acknowledge that as a fledgling reference discipline, IS continues to import more knowledge than it exports—especially from those journals representing the shared base of all COB disciplines. However, the steady increase in knowledge export to other COB disciplines signals the growing influence of IS as a reference discipline. The sharp increases in IS exports in the last decade mirrors the increased importance business organizations have placed on elevating information systems decisions to the level of strategic goals and objectives.

Spatial relationships discussion

The MDS and PCA analyses demonstrate that (a) field co-citation analysis is a valid means of defining disciplines and (b) the emergent clusters are valid definitions of intra- and

interdisciplinary relationships. A major contribution of this research is to (a) identify the different emphases within each discipline (b) identify the journals constituting each emphasis and (c) illustrate visually the relative distances among emphases and constituent journals. Researchers can use this information to explore different interdisciplinary research questions and connect with researchers pursuing similar interests, both of which are possible via perusing boundary-spanning journals. This research visually identifies groups of journals based on co-citation patterns, which indicates shared commonalities.

Possible intra- and interdisciplinary publication outlets are identified by locating journals near cluster boundaries or on the opposite side of the *Y* axis in relation to their own discipline. The proximity maps are used in conjunction with the PCA analyses. After locating a journal near a cluster boundary or in the overlap between two or more clusters, a researcher can check the journal loadings on the corresponding components to assess the degree to which the journal publishes research from a given discipline or general research area. A higher loading indicates more commonality with other journals in that cluster, thereby indicating possible shared interests.

The role played by many of the management-oriented journals contributed to the understanding of the intellectual structures of the COB disciplines. The management-oriented journals always cluster in the center of the proximity map. Accounting and Finance have strong discipline-defining clusters which are mostly independent of management-oriented journals. Accounting and Finance have more journals in common with each other than they do with IS or any of the other COB disciplines (see the online supplements). In contrast, Marketing and Entrepreneurship are defined in large part by their referential discipline Management. IS is unique in that it still has a strong relationship with Management but is defined by its own journals. IS is defined consistently by two clusters of IS journals. A third cluster comprised of management-oriented journals helps define IS when compared to Accounting and Finance, which have little relationship with Management. Even so, those management-oriented journals form their own cluster rather than being absorbed into the distinct IS clusters, further confirming IS as a discipline.

Other than Management, Accounting provides the greatest potential for direct interdisciplinary research as well as via the management-oriented journals. Journals in the Theoretical and Applied Accounting cluster were dispersed broadly and represented a variety of Accounting topics to which IS research could be applied. The Marketing journals in the Marketing Research and Psychology clusters might also be research outlets. Journals in those clusters were proximally closer to IS than were the Accounting journals, but their list of topics and scope statements only implied information systems through "technology innovation"—information systems could be only one subcategory of marketing technology. Researchers could use this research to identify possible intra- or interdisciplinary publication outlets within general areas of research defined by the discipline clusters. They could then peruse the resulting journal lists of topics and scope statements to generate creative ideas for research.

This research confirmed previous research (Nerur et al. 2005) which identified the socio-technical nature of IS foundational journals. As demonstrated by the dense clustering of foundational IS journals near the management-oriented journals, IS has positioned itself to provide strategic management solutions. *AMJ, AMR, ASQ, HBR, MgmtS, OScience* and *SMR* represent the primary interdisciplinary publication outlets between IS and other COB disciplines—especially Management, Marketing and Entrepreneurship, which were defined in large part by these journals. These journals are widely regarded in the field and have been employed in prior research assessing faculty production (Chua et al. 2002). A perusal of scope statements from the management-oriented journals revealed their interdisciplinarity and multidisciplinarity.

Previous research (Dennis et al. 2006; Kozar et al. 2006) compared IS and other COB discipline research production as demonstrated via publication in top COB discipline journals. A penalizing discrepancy exists between the number of IS publications in top-ranked journals compared to other COB discipline publication opportunities (Valacich et al. 2006). IS publication opportunities in top management journals are limited due to the sheer volume of manuscripts submitted from all COB disciplines. However, we disagree with the suggestion that such journals be removed from IS promotion and tenure journal rankings (Katerattanakul et al. 2005; Peffers and Tang 2003). Instead, we suggest that IS researchers continue to seek ways to integrate their research with evolving management needs from each discipline. We also recommend continued citation of IS journals to strengthen the within-discipline intellectual cohesiveness.

Limitations

A known limitation of bibliometric studies is the selection of journals used for analysis. This study utilized a far greater breadth and depth of journals than used in previous COB bibliometric studies. Our findings are based on those journals indexed in the ISI databases, resulting in 83% of the top-25 journals ranked by each discipline. Most of the omitted journals were not in the averaged top-10 list of ranked journals for each discipline. Exceptions included the following: *Journal of American Taxation Association* from Accounting; *Industry and Innovation* and *Economics of Innovation and New Technology* from Entrepreneurship; the *Journal of Marketing Management* and the *Journal of Business Strategy* from Management. The omitted journals could have influenced the results and conclusions; therefore, all results and conclusions pertain only to the journals reported in this study.

The journal selection for this study was biased towards North American journals. Many journal-ranking studies for business disciplines are conducted by North American authors, who differ from their European peers in their preferences of research methodologies, theoretical frameworks, and choice of journals (Chua et al. 2002). We used COB-discipline journal-ranking studies as a base for our journal selection. We did not discriminate between journal-ranking studies conducted by North American or other researchers. Future research could replicate and extend the current study by focusing on journal selections more representative of other world regions.

The research was focused on research interests within COB disciplines. Therefore, although the diversity of IS scholarship extends to publication opportunities in disciplines outside the COB (e.g., psychology or computer science), we omitted those disciplines from this analysis. Future research can build on this study by including non-COB allied disciplines in the analysis.

The longitudinal data from this study show an increasing trend for other COB disciplines to cite IS research, indicating that IS is establishing itself as a contributing discipline within the COB. The fact that researchers are looking beyond their own disciplines indicates a trend toward more interdisciplinary research. Further research is needed to analyze any trends toward interdisciplinarity and identify changes over time.

Conclusions

Real-world business problems rarely are constrained to one function and therefore interdisciplinary research is necessary if researchers want to make a relevant contribution to the

advancement of knowledge as it impacts business problems. This paper assessed the state of intra- and interdisciplinary research between IS and related COB disciplines using bibliometric research methods.

This study explored the intellectual structures of IS and related COB disciplines in order to identify potential intra- and interdisciplinary publication outlets. By analyzing the import/export citation data between IS and other COB disciplines, we showed that there is an increased export of IS literature to other COB disciplines with the sharpest increases to Marketing and Entrepreneurship. The increased export of IS knowledge to other COB disciplines demonstrates the growing influence of IS on other disciplines and further supports the argument that IS is becoming a reference discipline. By visualizing the spatial relationships among journals, we identified latent relationships between groups of journals. All other COB disciplines, except Finance, shared a group of common journals with IS, indicating an overlap in research interests. Building a more holistic understanding of the IS discipline and its relationship to other COB disciplines provides several benefits to the academic and business communities, as described below.

Our research provides information about general collaborative research area opportunities between IS and each other COB discipline. Previous studies (Acedo et al. 2006; Laband and Tollison 2000; Presser 1980) revealed an increase in coauthored papers associated with a corresponding improvement in paper quality and higher acceptance rate. External (outside one's own discipline) collaboration has a positive relationship with academic performance (Oh et al. 2005). Collaborations with coauthors from disciplines outside IS will provide new and different perspectives on established and emerging IS topics and could lead to innovative research streams. Our data identifies publication outlets for those research streams. Our data also indicates areas with very little interdisciplinary research (e.g., IS and Finance). Lack of interaction between a COB discipline and IS can be perceived as an opportunity for future, original interdisciplinary research.

The findings of this study can be used by researchers to identify promising journals to read and to target as research publication outlets, especially for interdisciplinary research. Practitioners and researchers can expand their areas of influence by becoming fluent in boundary-spanning research topics and by reading interdisciplinary journals. Our recommendation to read and publish in journals representing different disciplines differs from previous research (Chua et al. 2002; Katerattanakul et al. 2005; Peffers and Tang 2003) suggesting that non-IS journals be trimmed from IS promotion and tenure lists. IS researchers perceive as high quality and therefore reference journals that are not specifically targeted toward IS. Industry has moved to multifunctional processes and IS research needs to support that. A logical conclusion is to identify and encourage manuscript submission to publication outlets supporting interdisciplinary research. To that end, the MDS analysis illustrated the intellectual structure of IS with each of its allied COB disciplines.

Findings from this research inform promotion and tenure discussions among academicians. Interdisciplinary research presents a special challenge related to promotion and tenure evaluations (Borrego and Newswander 2008; National Academies Report 2004). Faculty members tend to evaluate others according to their own knowledge and values. For example, if a faculty member is publishing mainly in core IS journals, he/she might not put the same value on boundary-spanning journals. Tenure policy should be revised to ensure that interdisciplinary research receives the same considerations as disciplinary research (Chait 2002). Evaluation of interdisciplinary research requires the tenure committee members and the external reviewers to look beyond their own disciplines. The results of this research provide insights into the intellectual structure between IS and other COB disciplines, which can then be used to evaluate interdisciplinary research. For some general

best practices in evaluating promotion and tenure of interdisciplinary faculty, see (Pollack and Snir 2008).

Contributing to the promotion and tenure evaluations are the lists of acceptable journals. The multiple articles on IS journal rankings (Chan et al. 2006; Hardgrave and Walstrom 1997; Lim et al. 2009; Mylonopoulos and Theoharakis 2001; Peffers and Tang 2003; Rainer and Miller 2005; Walstrom et al. 1995), including discussions related to the validity of ranking procedures and resulting lists (Katerattanakul et al. 2005; Willcocks et al. 2008), attest to the importance of selecting an appropriate publication outlet for the given content, methodology and institutional restrictions (Chua et al. 2002). Traditional IS journal rankings are often used by promotion and tenure committees and external reviewers to judge research quality, but they rarely include interdisciplinary outlets. Rather than provide another list of ranked journals, we aggregated existing lists for IS and the following COB disciplines: Accounting, Entrepreneurship, Finance, Management and Marketing. We purposely included discipline-core, niche and practitioner-oriented journals in our analyses in order to facilitate both scholarly and applied influence (Gill and Bhattacherjee 2009; Levitt and Thelwall 2008; Pfeffer 2007). This study identifies the boundary-spanning journals (both research-oriented and practitioner-oriented) likely to publish interdisciplinary research related to IS and other COB disciplines. IS scholars can use the interdisciplinary outlets identified in this research to supplement the traditional departmental journal lists and position their research. We also encourage departments to use the findings from this research to expand their promotion and tenure journal lists to accommodate research interests of their faculty.

In an age of heightened emphasis on interdisciplinarity, differentiating disciplines by the "permeability" of their boundaries has become a common practice (Klein 1996, p. 38). High permeability indicates a large degree of exchange between the discipline and other disciplines. Disciplines with high permeability are more likely to be application-focused than those disciplines with less fluidity in their boundaries. Therefore, the identification of interdisciplinary venues for research can be used to identify "high permeability" areas for future collaborative efforts—efforts that may close the relevance gap for which academia is often criticized. As previously indicated, industry problems generally require a multifunctional approach whereas most scholarly research is still discipline based with little interaction among disciplines. This research helps IS researchers and practitioners bridge the divide between academe and industry by identifying journals that encourage interdisciplinary research.

A final benefit of this study is the contribution to the study of bibliometrics, which is being utilized at a greater extent within IS research. This work demonstrated the use of the field co-citation model by pairing IS with multiple COB disciplines. The results provided evidence that field co-citation is a useful model that can be used for disparate and similar disciplines and provides results that can inform practice, research, and policy.

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