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Citation Analyses in Information Systems

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Abstract. Few scientists that specialize in information systems would recognize the name one of the field's most cited authors, Ike Antkare. It is not that Antkare is from an obscure discipline. This aberration is the result of a vulnerability of citation analyses. A vulnerability proven with a computer program. Today, funding, promotion and tenure extension depend on the results of these analyses.
This paper explores the nature of citation analyses in the information systems (IS) field and classifies them based on an adapted framework of Zupic and Cater (2015). The results illustrate two types of citation analyses. The first type contains ranking studies using measures of the h-family index calculated on citation networks. The second type involves co-citation analysis applying cluster or factor analysis to determine the intellectual structure, trajectory or maturity.

Keywords: Citation analysis, scientometrics, bibliometrics.

Introduction

Who has met Ike Antkare, one of the most cited computer scientists of the 21st century? Nobody. In actuality, Antkare's volume of citations is not the result of distinguished research contributions. It is because a computer program, developed by Cyril Labbé, created nonsense papers that cite each other to increase the citation indices of Ike Antkare (van Noorden 2014). In a system where these indices determine who gets hired, promoted and achieves tenure extension (Cuellar et al. 2016; Rainer and Miller 2005), it is important to understand the creation of these analyses. Even scholars that publish regularly must confront these vulnerabilities in citation analyses, e.g., when choosing a journal for publication or the next university for a job.

Scientrometrics, the quantification of scientific work, is devoted to the analysis of scientific performance and the source of all these indices. Hassan and Loebbecke (2016) developed a framework to classify scientometric studies in IS. They identified several unexplored application fields, but they did not analyze the processes and underlying methods. Other contributions, notably Mingers and Leydesdorff (2015) focused on source development of citation data and citation metrics. Nevertheless, there is no contribution that analyzes the relationship between the purpose/objective of studies and their methods used.

This paper aims to fill this gap and explore the underlying relationships between the objectives and methods of citation analyses in IS. It pursues the following research questions:

What are citation analyses used for?
How are citation analyses conducted?

To answer these questions, the five-step framework to conduct a bibliometric analysis proposed by Zupic and Cater (2015) was used. The framework is based on 81 bibliometric management and organization studies. This paper aims to provide an equal overview of the citation analyses in the IS field, but also investigates the indicators used and the relationships between the chosen characteristics of a citation analysis.

The next section gives an overview of the framework for bibliometric analyses. After briefly describing the methodological processing of collecting citation analysis in the IS field, these studies are descriptively analyzed. The following discussion focuses on the audit of several statements found in the IS literature and proposes categories of citation analyses. The conclusion completes the paper.

Conceptual Background

Citation analyses are part of bibliometrics and scientometrics. They use quantitative indicators to retrieve information based on references. Information scientists discussed the clear definition of the terms of bibliometrics and scientometrics as well as informetrics, altmetrics and webometrics (Hood and Wilson 2001).

Brookes (Brookes 1990) stated: "Though the techniques of scientometrics and bibliometrics are closely similar, their different roles are distinguished by their very different contexts." While bibliometrics focuses on "the application of mathematics and statistical methods to books and other media of communication" (Pritschard 1969), scientometrics includes all quantitative aspects of the science of science, communication in science and science policy (Hood and Wilson 2001).

Informetrics is broader term that includes scientometrics and bibliometrics (Hood and Wilson 2001) as well as webometrics. The latter uses contemporary methodologies to analyze the web. Altmetrics is an alternative to citation metrics with a focus on the consequence of web publications (Björneborn and Ingwersen 2001; Glänzel and Gorraiz 2015).

Given the focus on citation analyses, not all bibliometric studies are included in the scope of this paper. For instance, counting articles or authors per article (Cocosila et al. 2009) or a co-word analysis (Liu et al. 2016) are explicitly excluded. This is important as studies counting the number of pages of articles belong to scientometrics and miss the underlying network character of citation analyses. Although Zupic and Cater (2015) claim that their framework is for bibliometric studies, as the majority of their studies are citation analyses, their framework is particularly suited for citation analysis studies. Their bibliometric studies follow nine criteria (*bibliometric methods, multiple time-periods, selection methods, databases, bibliometric software, unit of analysis, grouping methods, visualization methods, and visualization software*).

A random sample of citation analyses from IS confirmed the presumption that the software used for visualization and bibliometric analysis is often not reported. Hence, these criterions are excluded from this analysis.

With a focus on the relationship and dependencies between the different criteria, the unit of analysis and the bibliographic method are combined in a two-dimensional matrix. This allows analysis of the bibliographic methods used and units of analysis, but also of possible assumptions such as that author-based analysis always uses co-citation.

The indications from the grouping method and visualization method also correlate. It is not surprising that studies using multidimensional scaling (MDS) for grouping also use MDS as a method of visualization. Moreover, the classification of network analysis as a visualization method, as proposed by Zupic & Carter (2015), is problematic. The network analysis is based on the network theory (Wasserman and Faust 1994). Besides tools for the visualization of networks, it also offers a variety of indicators to measure the centrality, distance and other characteristics of a network. Following this argument, a pooling without differentiation of the clustering method and the visualization method solves the imprecisions and doubling of the originally terms used.

The variety of indicators is underrepresented in the analysis of Zupic and Carter (2015). With the introduction of the h-index (Hirsch 2005) and its derivatives (Alonso et al. 2010), the number of indicators has recently increased (Takeda et al. 2010). Katerattanakul et al. (2003) determined that journal quality is multifaceted and therefore needs several different indices (in their case, 8). Each indicator has its own advantages and disadvantages (Bordons et al. 2002; Hirsch 2005). This study gives a descriptive overview of the use of indicators and their context of use. To achieve that in this paper, the grouping method and visualization method criteria are merged and the new criteria has been extended with all used indicators.

The selection method, database and bibliometric method are adopted without major adaptations. The objective completes this paper's set of criteria and answers the first research question. The objective and the bibliometric method were the only criteria used by Zupic and Carter (2015) where relationship is documented.

Several studies have listed or documented the objectives of bibliometric studies or citation analyses (Hassan and Loebbecke 2016; Polites and Watson 2009; Zupic and Cater 2015). As the objectives of the studies were required to be clustered, a listing approach, as used be by Polites and Watson (2009), can not be used. The framework must classify scientometric studies. While Hassan and Loebbecke (2016) cluster studies the proposed perspectives (functionalist, normative, interpretive and symbolic) are not suited to answer the first research question of this paper. The framework targets a more abstract level, whereas this study investigates citation analyses on a material and practical level. Zupic and Carter's (2015) list of research questions for the different bibliometric methods addresses this level. As this list contains 24 items, it is also not well suited for clustering. Nevertheless, the list was used as a basis for the later developed objective classification matrix.

The dimension of the analysis method is the core of this study. To date, no study has investigated the use of different bibliometric indicators in its contextual use in the IS discipline. In the published literature, several studies discuss advantages and disadvantages of citation indexes (Glänzel and Moed 2002; Jennings 1998; Seglen 1997). While the earliest studies only count the number of citations (Hamilton and Ives 1982), later studies add further data analysis techniques like clustering, factor analysis, and multidimensional scaling (Culnan and Swanson 1986). Although the Institute for Scientific Information (ISI) has used the impact factor to evaluate journals' quality a century ago (Garfield 1972), it was not used in academic studies in the IS discipline before 2000 (DuBois and Reeb 2000).

In contrast to the impact factor, which reflects the number of citations an article receives within the first two years (Garfield 1972), the h-index considers the achievements across a lifespan (Hirsch 2005). To compensate the effect that the age of the unit of analysis has a significant impact on the h-index, a contemporary h-index (hc-index), a trend h-index and a normalized h-index were proposed (Anderson et al. 2008; Sidiropoulos et al. 2007). Other scientists proposed a modified h-index (hm-index) to compensate the diverse authorship behaviors in different disciplines (Batista et al. 2006). The hg-index (Alonso et al. 2010) combines the h-index and the g-index (Egghe 2006), which, like the e-index (Zhang 2009), increases the weight of highly cited articles.

Recent analytical trends are towards social network analysis (SNA) methods. The range of indicators to measure the centrality strongly varies. Besides simple, non-directional relations measurements (degree, closeness and betweenness) (Wasserman and Faust 1994), the Bonacich power centrality (Bonacich

1987) and freeman centrality (Freeman 1978) can be used to determine the centrality. The next step when using SNA is to build clusters in a network. For such a cluster analysis, several cluster coefficients (e.g., Jaccard (Jaccard 1912) or Tanimoto (Rogers and Tanimoto 1960)) and algorithms (Murtagh and Contreras 2012) exist. Alternatively, variables instead of objects can be clustered using factor analysis.

The bibliometric laws complete the dimension of analysis methods. Lotka's law (Lotka 1926) states that the number of authors that published n articles is proportional with n^{-2}. Another bibliometric law is Garfield's law of concentration (Garfield 1971), which states that all journals can be grouped into three categories: core, middle and border area.

The dimension of the bibliometric methods as well as the units of analysis were described in detail by Zupic and Carter (2015). As this study focuses on citation analyses, co-author and co-word analysis are outside the scope. They are not based on citation but on the rare occurrence of authors or words appearing together in a single article. Following, citation analysis, co-citation (Small 1973) and bibliographic coupling (Kessler 1963) remain. Like Gallivan and Tao (2014), the paper classifies the citation studies additionally in terms of the unit of analysis. Although they did not differentiate between bibliographic coupling and co-citation, their overview of the used methods in the IS discipline serves as a good starting point. Some of their claims, like that there are "no papers that employed journal co-citation analysis" (Gallivan and Tao 2014) can be revised this way.

The definition of the selection methods in Zupic and Carter (2015) is limited. They did not define their categories (journal, search, qualitative and other), with the exception of some examples and the note that the methods can be combined. Hence, this study will use this dimension (selection method) to form an explorative perspective. Depending on the results of the analysis of the studies, the categories may need adjustment.

The final dimension concerns the data source. This is a widely discussed topic in scientometrics (Harzing and Alakangas 2016). Beside the long-established Web of Science (Garfield 1964), with Scopus (2004) and Google Scholar (2006) (Harzing and Alakangas 2016), two additional major citation databases have been established. The results for organizational science indicate a strong dominance of the Web of Science (69.1%) (Zupic and Cater 2015). Unfortunately, the results do not display the chronological development of the proportions. They also only consider Scopus, not Google Scholar, as an alternative data source. Other alternative services like Microsoft Academic Search (Harzing 2016) are rarely used. Even for Google Scholar, Gallivan and Tao "were unable to locate any published studies that relied on Google Scholar as the citation data source for performing co-citation analysis" (Gallivan and Tao 2014). This and other statements were investigated in this study.

Methodology

As studies investigating citation analyses in the IS field are rare, an explorative approach was chosen. In the first step, a systematic literature review (vom Brocke et al. 2009) was used to identify citation analysis studies in IS. Following the suggestion of Webster and Watson (2002) the *"AIS basket of eight"* and the top AIS conferences (AMCIS, ECIS, ICIS and PACIS) were examined to identify an initial set of studies (see Table 1). An expansion on all outlets in these databases would bring up several more citation analyses from different fields, as these are all (except for the AIS Library) cross-disciplinary literature databases such as Science Direct. For this database this would result in around 400 studies. The vast majority of these studies are from different disciplines. This study aims on a representative, rather than a comprehensive, collection. While the first iteration was restricted to theses top outlets in order to maintain precision (Büttcher et al. 2010) and quality of publication, the backward and forward search extends the scope for a representative overview.

After excluding studies that did not conduct a citation analysis, 34 studies were left. It should be noted that the missing keyword search of SpringerLink resulted in 17 false negative (type 2 errors). The only publication containing 'citation analysis' in the keywords, which was excluded, is Li et al. (2009). They analyzed citations of patents and were therefore excluded.

Using a reference backward search (Levy and Ellis 2006), 45 further studies were identified. After a second sorting, 24 of the 45 studies remained. A concurrently executed author forward search resulted in five additional studies. The second iteration of the backward search also revealed only eleven studies.

Table 1. Literature search			
Outlets	Database	Search term	Hits
EJIS	Springer Link	"citation analysis"	15
ISJ	EBSCOhost	KW"citation analysis"	0
ISR	Informs	citation analysis (in Keywords)	0
JIT	Springer Link	"citation analysis"	7
JMIS	EBSCOhost	KW"citation analysis"	2
JAIS	EBSCOhost	KW"citation analysis"	5
MISQ	EBSCOhost	KW"citation analysis"	4
JSIS	ScienceDirect	TITLE-ABSTR-KEY(citation analysis)	1
AMCIS	AIS Library	“citation analysis” (in subject)	6
ECIS	AIS Library	“citation analysis” (in subject)	4
ICIS	AIS Library	“citation analysis” (in subject)	3
PACIS	AIS Library	“citation analysis” (in subject)	5
			52

In the following phase, notices for all studies and lists of manifestations of the five characteristics (database, selection method, bibliometric method, analyzing method, objective) were created. It turned out that to avoid counting studies multiple times, studies like Grover et al. (2006b), Wade et al. (2006b) and the commentary of each other’s studies (Grover et al. 2006a; Wade et al. 2006a) were removed from the list. Beside this, bibliographic studies analyzing co-authorship (Cocosila et al. 2009) or journal ranking comparison (Rainer and Miller 2005) were also excluded, as these articles do not apply citation analysis.

In the next step, the objectives and methods of analysis were clustered. In the case of the objectives, a two-dimensional matrix became apparent that was similar to the bibliometric method. Every objective had a descriptive goal (ranking, maturity, trajectory or intellectual structure) and a hierarchical level (document, author, journal, discipline or topic). Due to the number of different methods of analysis used within the citation analyses, a clustering based on their resemblance was necessary. Rarely used indicators (e.g., the number of citations per article, author or time) were grouped as relative number of citations. Indicators that were described on different levels were aggregated. While most contributions defined the type of centrality (e.g. between, closeness etc.), others did not go into detail.

Analysis

Gallivan and Tao (2014) stated that they were not able to find a study applying co-citation that drew their data elsewhere than the Web of Science. Even though two studies (Bernroider et al. 2013; Hansen et al. 2006) using Google Scholar were found in this study, the results confirm the general tendency that these studies usually apply the Web of Science to generate the data for a co-citation analysis. This is in contrast to the general trend, that Google Scholar is becoming the preferred source for citation analyses (Harzing 2016; Harzing and Alakangas 2016). This is even more surprising as in Information Systems and its cognate disciplines, like Computer Science, grey literature is important but the Web of Science in contrast to Google Scholar does not list this literature.

Google Scholar, on the other hand, is mainly employed for ranking studies. These contributions have to balance their scope of considered publication sources carefully. When choosing a narrow scope, which some researchers reproach the Web of Science of doing because of its selection of journals, publications with major practical impact are underrated. On the other hand, a citation in a practical journal has to be rated differently from a citation in a top journal. Therefore, the choice of data source should consider the objective of the analysis. Beside these options, the new Microsoft Academic (Harzing 2016) offers an additional choice, which makes the decision more complex.

In IS, the Web of Science is still the dominating data source. However, as Figure 1 presents, more and more studies use Google Scholar (launched between 2004 and 2006). During that time, Hirsch (2005)

published the h-index. These two occurrences mark a change in the citation analyses (dotted line in the diagram).

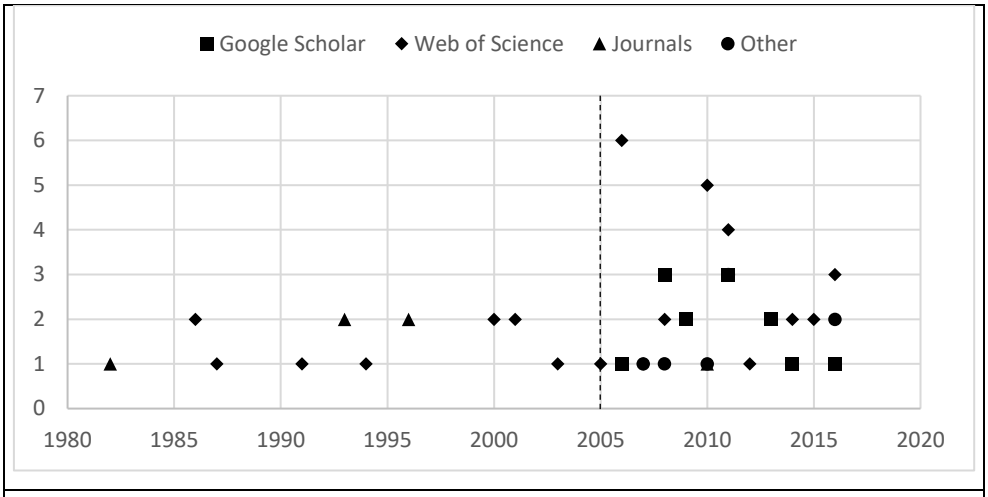

Figure 1. Longitudinal development of the used databases

The number of citation analyses published in IS has strongly increased, but also the methods of analysis have changed. The first ranking studies (Cooper et al. 1993; Holsapple et al. 1994) used the number of citations and relative number of citations to assess journals according to their influence. Later studies applied more complex indicators, like the impact factor (DuBois and Reeb 2000; Katerattanakul and Han 2003; Walstrom and Leonard 2000). The introduction of the h-index saw several studies calculate the h-index for authors and institutions (Dwivedi and Kuljis 2008; Truex III et al. 2008) or journals (Bontis and Serenko 2009; Cuellar et al. 2008; Truex III et al. 2009).

Beside the h-index, its many derivatives played a part in contributing to the increased number of ranking studies. Table 2 gives an overview of the indicators used. Due to the unique indicators (e.g. Katerattanakul and Han 2003), especially utilized in the earlier studies, this study pooled them as relative number of citations. The same was done for the different measures of centrality. Indicators that are barely related to citation analysis, like the type of cited publications (Hamilton and Ives 1982), are not listed in the table.

Table 2. Utilized methods of analysis

Indicators	No. of studies	Indicator	No. of studies
No. of citations	37	e-index	1
Rel. no. of citation	13	Lotka's law	2
Citation ratio	1	Yule-Simon's law	1
Cited half-life	1	Centrality	8
Impact factor	3	Density	2
h-index	10	Fragmentation index	2
hc-index	7	Cluster Analysis	9
hg-index	2	Factor Analysis	13
hm-index	1	Multidimensional Scaling	8
g-index	5		

The results illustrate the many different derivatives of the h-index (hc-index, hg-index, hm-index, g-index, e-index). These and the relative number of citations, the citation ratio, the cited half-life, and the impact factor are used to rank authors, institutions, publications or journals.

As Gallivan and Tao (2014) stated, the majority of citation analyses include descriptive ranking studies that produce a ranking of documents (Córdoba et al. 2012; Stein et al. 2016; Walstrom and Leonard 2000), authors (Cuellar et al. 2016; Serenko et al. 2011; Stein et al. 2016; Takeda et al. 2011; Truex III et al. 2008), or journals (Bernroider et al. 2013; Bontis and Serenko 2009; Cooper et al. 1993; DuBois and Reeb 2000; Grover et al. 2006a; Hamilton and Ives 1982; Holsapple et al. 1994; Katerattanakul and Han 2003; Lowry et al. 2013). A unique study of note is the obituary of Heinz Klein (Truex III et al. 2011), which exhibits a demonstration of his influence and achievements.

Beside the two observed phases of indicators used within ranking studies, the simple and relative number of citations, as well as the impact factor and the family of the h-index (Hirsch 2005), the SNA was proposed as an alternative approach (Truex III et al. 2011). The objectives of the application of SNA varies from ranking journals (Lowry et al. 2004) over the intellectual structure of IS (Oh et al. 2006), the trajectory of platforms (Porch et al. 2015), to the maturity of cloud computing (Wang et al. 2016).

Only a very few studies, like Cordoba et al. (2012), use a ranking approach as an intermediate result. They applied a document co-citation analysis with the most cited articles of the *MISQ* and *EJIS*. These two stages were both recorded in this study. The source of data is the Web of Science, and they use a simple document citation analysis using only the number of citations to rank documents. Hence, this contribution has two bibliometric methods and two objectives. This is quite unusual.

Also uncommon is the use of citation analysis to determine the intellectual structure. But two studies used citation analysis to determine the intellectual structure of a topic (Fischer 2011; Serenko et al. 2010), six for IS as a discipline (Hamilton and Ives 1982; Moody et al. 2010; Nerur et al. 2005; Oh et al; Polites and Watson 2009; Takeda et al. 2010), and Mingers and Leydesdorff (2014) for the determination of the intellectual structure of business and management. Generally, co-citation analysis is particularly well-suited to gain an understanding of the intellectual structure or a research trajectory by studying relationships (Raghuram et al. 2010).

This bibliometric method constitutes the second type of citation analysis, co-citation analysis. For this method, the literature shows contrary results. Gallivan and Tao (2014) stated, that there is no co-citation analysis using journals as their unit of analysis. Shiau et al. (2016), however, call the document co-citation analysis, the author co-citation analysis and the journal co-citation analysis all equally as frequently seen. The results of this analysis only reveal one study (Mingers and Leydesdorff 2015) using journal co-citation analysis.

Co-citation analyses usually aim to determine the intellectual structure, the trajectory or the maturity of IS as a discipline or specific themes. Studies investigating the intellectual structure (Renaud et al. 2016; Shiau et al. 2016; Yang et al. 2016) use either: the dimension author, institution, or document. The trajectory extends that view by the chronological development (Culnan 1986; Culnan and Swanson 1986; Lang et al. 2010; Porch et al. 2015). The maturity, however, compares disciplines or topics. These studies use different approaches from the analysis of incoming and outgoing references (Grover et al. 2006b) to social network and factor analysis (Wang et al. 2016).

Independent from the objective, the vast majority of citation studies following these goals use co-citation as their bibliometric method. They use the number of citations to generate a matrix based on either authors or documents using an initial set of articles. Depending on the numbers, the pairs with the highest co-citations are selected, and a network is created with the authors or articles as nodes and the citations as links. Based on these networks, a factor (Gallivan and Tao 2014; Hsiao and Yang 2011; Pilkington and Meredith 2009; Renauld et al. 2012) or cluster analysis (Raghuram et al. 2010) is often performed. The results are often represented using MDS (Eom et al. 1993). Recently several studies applied SNA. The first study (Oh et al. 2006) measuring centrality was published in 2006. Several other studies followed soon after (Bernroider et al. 2013; Kim and Barnett 2008; Lowry et al. 2013; Polites and Watson 2009; Wang et al. 2016).

Many cluster and factor analyses (Shiau et al. 2016; Yang et al. 2016) do not provide any information about the similarity coefficients, clustering algorithms and methods to determine the optimal number of clusters used in the study (Härdle and Simar 2015). In contrast, studies using SNA usually detail the indicators used (Lowry et al. 2013; Porch et al. 2015; Takeda et al. 2011).

Although the procedures of co-citation analyses look alike, there are no studies using the same method of analysis that aim toward different objectives. Contrarily, there are several different approaches to answer the same or like research question (Grover et al. 2006a; Wade et al. 2006a). Although there are studies that determine the intellectual structure, majority or trajectory that use the number of citation and MDS, additional methods set their objective. For example, the combination of the number of

citations, a factor analysis and MDS aims for the intellectual structure of a topic (Eom et al. 1993; Pilkington and Meredith 2009; Renauld et al. 2012).

Comparing the overall results (Table 3) partly confirms the findings of Zupic and Cater (2015). However, differences between organizational science and information systems are exhibited. The smaller proportion of co-citation studies may be due to the relatively recent advance of information systems. The ranking studies, which dominated the field in the last decade, commonly use citation analysis.

Table 3. Results comparison with Zupic and Carter (2015)

Criteria	Manifestation	Studies	Proportion	Zupic and Carter
Bibliometric method	Citation	44	66.7%	66.7%
	Co-citation	26	39.4%	72.8%
	Bibliographic coupling	0	0.0%	3.7%
	Co-author	-	-	7.4%
	Co-word	-	-	13.6%
	No	-	-	48.1%
Selection method	Journal	38	57.6%	50.6%
	Search	16	24.2%	58.0%
	Qualitative	2	3.0%	22.2%
	Other	10	15.2%	6.2%
Database	SSCI	41	62.1%	69.1%
	Google Scholar	13	19.7%	-
	Scopus	0	0.0%	3.7%
	Other	6	9.1%	4.9%
	Self-constructed	7	10.6%	16.0%
	Not reported	2	3.0%	6.2%
Unit of analysis	Document	23	34.8%	55.6%
	Author	24	36.4%	33.3%
	Journal	21	31.8%	8.6%

The higher proportion of Google Scholar could be because most studies were published after 2005 and the popularity of Publish or Perish (Harzing 2007), a bibliometric tool, only supported Google Scholar before 2016.

Discussion

Although this study does not claim to be a comprehensive selection, it is the largest known collection of citation studies in IS. It contains, beside the studies of other collections of publications in the field (Gallivan and Tao 2014; Hassan and Loebbecke 2016; Mingers and Harzing 2007), several additional studies to achieve a representative picture.

The focus of this analysis was on citation analysis and its methodologies. The case of the two studies (Grover et al. 2006b; Wade et al. 2006b) conducting the same analysis with the same objective and coming to a different result illustrates the sensitivity of citation analyses and their interpretation. Both studies used Web of Science and a selection of journals to generate their data. They used the number of citation on a journal citation network and yet generated different results. While Wade et al. (2006b) came to the conclusion that IS has not yet attained the status of a reference discipline, Grover et al. (2006b) reached a different conclusion. Both research teams cross referenced each other's approach and discussed their scope choices (Grover et al. 2006a; Wade et al. 2006a). Chua et al. (2002) demonstrated the sensitivity of the choice of journal basket on the measures and their validity.

The cases of Grove et al. (2006b; 2006a) and Wade et al. (2006a, 2006b) illustrate the importance that the audience of a citation analysis critically reflects the results and conclusions. It is essential to be able to systematically understand the decisions made and their implications. This study adapted the framework of Zupic and Carter (2015) to classify citation analyses in IS. The results reveal that rankings use citation analysis as their bibliometric method without exception.

Most of the few citation analyses ranking publications (Stein et al. 2016) or authors (Truex III et al. 2009) use the outcomes as a mid-result. For example, to generate a set of publications for a co-citation analysis (Bernroider et al. 2013; Córdoba et al. 2012; Cuellar et al. 2016; Sadiq et al. 2011). The more popular journal citation analyses, however, are often used as a substantive contribution (Bontis and Serenko 2009; DuBois and Reeb 2000; Holsapple et al. 1994; Lowry et al. 2013). Although they all rank journals, their criteria differ from measuring the impact with the impact factor (Lowry et al. 2013) to a multiple criteria assessment of the quality (Forgionne and Kohli 2001).

Another application of the ranking capability of citation analysis was not found, although the character could be used within literature search, as an example. This finding confirms other results (Hassan and Loebbecke 2016), that citation analysis have yet not been used as a literature search tool. This is a prominent gap and highlights the need for bibliometric tools in literature searches.

The second identified type uses co-citation analysis to determine the intellectual structure, trajectory or maturity of IS or a subfield of IS (e.g. decision support systems). Although the objective of co-citation studies varies, they all follow a straightforward procedure finishing with a factor or cluster analysis sometimes combined with MDS. Recently, SNAs have also been used to determine the intellectual structure (Kim and Barnett 2008). Beside the upcoming use of SNA in citation analysis, another emerging trend that has not been used in IS is the application of bibliometric methods for the detection of trends in research (Glänzel and Thijs 2012; Zitt 2015).

Table 4 summarizes the common options for the five dimensions including justification for their inclusion. Upon scrutinization of the summary, some relationships can be identified. The table, and data, show a strong dependency between the objective and bibliometric method. The method of analysis depends on the bibliometric method as well as on the objective. The h-index ranks the unit of analysis and is calculated based on a citation network. The selection method and database, however, are sometimes not well reported and in very few cases scrutinized. Usually the choice is related to the accessibility of databases and tools. In many cases Google Scholar is not reported as the used database, but Publish or Perish (Harzing 2007). Only through the date of publication (before 2013) and the statement of Harzing (2016) can these studies can be unambiguously identified as a study using Google Scholar.

Table 4. Conducting citation analysis

	Dimension	Options				
Conducted	Database	Web of Science • Selective collection of outlets	Google Scholar • Comprehensive • Includes grey literature	MS Academics • Alternative for WoS	Journal • Selective • Not recommended	
	Selection method	Comprehensive • General statements	Search • Systematic literature review • Topic-oriented	Journal • Topic-oriented • Comparisons	Qualitative • Subjective	
	Bibliometric method	Citation analysis • Ranking • SNA (Intellectual structure, trajectory, maturity)			Co-citation analysis • Intellectual structure • Trajectory • Maturity	
	Method of analysis	Sim. number of citations • Co-citation • Comparisons	Rel. number of citations • Ranking • Comparisons	h-family index • Ranking • Citation analysis	SNA • Explor-ative	Multivariate analysis • Co-citation analysis
use	Objective	Ranking	Intellectual structure	Trajectory	Maturity	

Conclusion

This paper aims to analyze the objectives and procedures of citation analyses. The framework for conducting bibliometric analysis was adjusted and used to classify citation studies. In contrast to Zupic and Carter (2015), this study focuses more on the methods to analyze citation networks. As co-word and co-authorship based on the number of occurrences in conjunction with two words or authors, the indicators evidently distinguish from studies considering references.

Although a wide-scale literature search was conducted, this study does not claim to be a comprehensive analysis, but rather a representative analysis. As the proportion of different bibliometric methods is of secondary interest, this analysis considers all studies despite the implication of replication studies. Similar studies from the same author or team of authors (Eom et al. 1993; Eom 1996; Eom and Farris 1996) were all considered.

Finally, 66 citation analyses were classified. The results represent an overview of the purposes for which citation analyses are used in the IS discipline. The two identified types of citation analyses are ranking studies which nowadays mainly use measures of the h-index family. Co-citation analyses, the second identified type, is used to determine the intellectual structure, trajectory or maturity of IS or a specific topic (e.g. knowledge management). They usually use a factor or cluster analysis to group the authors or publication. Furthermore, SNAs are increasingly used for the same objectives by utilizing co-citation as well as citation networks.

The adapted framework, with its options for every dimension (see Table 4), serve as a guideline for interested scientists for the evaluation and classification of citation analysis as well as for authors conducting a citation analysis.

References

Alonso, S., Cabrerizo, F. J., Herrera-Viedma, E., and Herrera, F. 2010. "hg-index: A new index to characterize the scientific output of researchers based on the h- and g-indices," *Scientometrics* (82:2), pp. 391–400.

Anderson, T. R., Hankin, R. K. S., and Killworth, P. D. 2008. "Beyond the Durfee square: Enhancing the h-index to score total publication output," *Scientometrics* (76:3), pp. 577–588.

Batista, P. D., Campiteli, M. G., and Kinouchi, O. 2006. "Is it possible to compare researchers with different scientific interests?" *Scientometrics* (68:1), pp. 179–189.

Bernroider, E. W. N., Pilkington, A., and Córdoba, J.-R. 2013. "Research in information systems: A study of diversity and inter-disciplinary discourse in the AIS basket journals between 1995 and 2011," *Journal of Information Technology* (28:1), pp. 74–89.

Björneborn, L., and Ingwersen, P. 2001. "Perspective of webometrics," *Scientometrics* (50:1), pp. 65–82.

Bonacich, P. 1987. "Power and Centrality: A Family of Measures," *American Journal of Sociology* (92:5), pp. 1170–1182.

Bontis, N., and Serenko, A. 2009. "A follow-up ranking of academic journals," *Journal of Knowledge Management* (13:1), pp. 16–26.

Bordons, M., Fernández, M., and Gómez, I. 2002. "Advantages and limitations in the use of impact factor measures for the assessment of research performance," *Scientometrics* (53:2), pp. 195–206.

Brookes, B. C. 1990. "Biblio-, Sciento-, Infor-metrics???: What are we talking about?" in *Informetrics 89/90*, L. Egghe and R. Rousseau (eds.), Delgium, pp. 31–43.

Büttcher, S., Clarke, C. L. A., and Cormack, G. V. 2010. *Information retrieval*: *Implementing and evaluating search engines*, Cambridge, Mass.: MIT Press.

Chua, C., Cao, L., Cousins, K., and Straub, D. 2002. "Measuring Researcher-Production in Information Systems," *Journal of the Association for Information Systems* (3:1).

Cocosila, M., Serenko, A., and Turel, O. 2009. "A Scientometric Study of Information Systems Conferences: Exploring ICIS, PACIS and ASAC," in *AMCIS 2009 Proceedings*, K. Kendall and U. Varshney (eds.), San Francisco. 6.8.-9.8.

Cooper, R., Blair, D., and Pao, M. 1993. "Communicating MIS Research: A Citation Study of Journal Influence," *Information Processing & Management* (29:1), pp. 113–127.

Córdoba, J.-R., Pilkington, A., and Bernroider, E. W. N. 2012. "Information systems as a discipline in the making: Comparing EJIS and MISQ between 1995 and 2008," *European Journal of Information Systems* (21:5), pp. 479–495.

Cuellar, M., Takeda, H., and Truex III, D. 2008. "The Hirsch Family of Bibliometric Indices as an Improved Measure of IS Academic Journal Impact," in *AMCIS 2008 Proceedings*, Toronto, Ontario, Canada. August 14-17.

Cuellar, M., Takeda, H., Vidgen, R., and Truex III, D. 2016. "Ideational Influence, Connectedness, and Venue Representation: Making an Assessment of Scholarly Capital," *Journal of the Association for Information Systems* (17:1), pp. 1–28.

Culnan, M. 1986. "The Intellectual Development of Management Information Systems, 1972-1982: A co-citation analysis," *Management Science* (32:2).

Culnan, M., and Swanson, B. 1986. "Researchin Management Information Systems, 1980-1984: Points of Work and Reference," *MIS Quarterly* (10:3), pp. 289–302.

DuBois, F., and Reeb, D. 2000. "Ranking the International Business Journals," *Journal of International Business Studies* (31:4), pp. 689–704.

Dwivedi, Y. K., and Kuljis, J. 2008. "Profile of IS research published in the European Journal of Information Systems," *European Journal of Information Systems* (17:6), pp. 678–693.

Egghe, L. 2006. "Theory and practise of the g-index," *Scientometrics* (69:1), pp. 131–152.

Eom, S. B. 1996. "Mapping the intellectual structure of research in decision support systems through author cocitation analysis (1971–1993)," *Decision Support Systems* (16:4), pp. 315–338.

Eom, S. B., and Farris, R. 1996. "The contributions of organizational science to the development of decision support systems research subspecialties," *Journal of the American Society for Information Science* (47:12), pp. 941–952.

Eom, S. B., Lee, S. M., and Kim, J. K. 1993. "The intellectual structure of decision support systems (1971–1989)," *Decision Support Systems* (10:1), pp. 19–35.

Fischer, C. 2011. "The Information Systems Design Science Research Body Of Knowledge: A Citation Analysis In Recent Top-Journal Publications," in *PACIS 2011*: *Quality Research in Pacific Asia*, P. Seddon and S. Gregor (eds.), Brisbane, Australia. 7-11 July.

Forgionne, G. A., and Kohli, R. 2001. “A multiple criteria assessment of decision technology system journal quality,” *Information & Management* (38:7), pp. 421–435.
Freeman, L. C. 1978. “Centrality in social networks conceptual clarification,” *Social Networks* (1:3), pp. 215–239.
Gallivan, M., and Tao, Y. 2014. “The Value of Co-Citation Analysis for Understanding a Field's Intellectual Structure: An Application to Healthcare Information Technology (HIT) Research,” in *AMCIS 2014 Proceedings*, Savannah, Georgia, USA. August 7-9.
Garfield, E. 1964. “"Science Citation Index": A new dimension in indexing,” *Science* (144:3619), pp. 649–654.
Garfield, E. 1971. “The mystery of the transposed journal lists: wherein Bradford's Law of Scattering is generalized according to Garfield's Law of Concentration,” *Essays of an Information Scientist* (1:17), pp. 222–223.
Garfield, E. 1972. “Citation Analysis as a Tool in Journal Evaluation: Journals can be ranked by frequency and impact of citations for science policy studies.,” *Science* (178:4060), pp. 471–479.
Glänzel, W., and Gorraiz, J. 2015. “Usage metrics versus altmetrics: Confusing terminology?” *Scientometrics* (102:3), pp. 2161–2164.
Glänzel, W., and Moed, H. 2002. “Journal impact measures in bibliometric research,” *Scientometrics* (53:2), pp. 171–193.
Glänzel, W., and Thijs, B. 2012. “Using ‘core documents’ for detecting and labelling new emerging topics,” *Scientometrics* (91:2), pp. 399–416.
Grover, V., Ayyagari, R., Gokhale, R., and Lim, J. 2006a. “About Reference Disciplines and Reference Differences: A Critique of Wade et al.,” *Journal of the Association for Information Systems* (7:5), pp. 336–350.
Grover, V., Ayyagari, R., Gokhale, R., Lim, J., and Coffey, J. 2006b. “A Citation Analysis of the Evolution and State of Information Systems within a Constellation of Reference Disciplines,” *Journal of the Association for Information Systems* (7:5), pp. 270–325.
Hamilton, S., and Ives, B. 1982. “Knowledge Utilization among MIS Researchers,” *MIS Quarterly* (6:4), p. 61.
Hansen, S., Lyytinen, K., and Markus, L. 2006. “The Legacy of "Power and Politics" in Disciplinary Discourse: A Citation Analysis,” in *ICIS 2006 Proceedings*.
Härdle, W. K., and Simar, L. 2015. *Applied Multivariate Statistical Analysis*, Berlin, Heidelberg: Springer Berlin Heidelberg.
Harzing, A.-W. 2007. *Publish or Perish*. http://www.harzing.com/pop.htm.
Harzing, A.-W. 2016. “Microsoft Academic (Search): A Phoenix arisen from the ashes?” *Scientometrics* .
Harzing, A.-W., and Alakangas, S. 2016. “Google Scholar, Scopus and the Web of Science: A longitudinal and cross-disciplinary comparison,” *Scientometrics* (106:2), pp. 787–804.
Hassan, N. R., and Loebbecke, C. 2016. “Engaging scientometrics in information systems,” *Journal of Information Technology* .
Hirsch, J. 2005. “An index to quantify an individual's scientific research output,” *Proceedings of the National Academy of Sciences* (102:46), pp. 16569–16572.
Holsapple, C., Johnson, E., Manakyan, H., and Tanner, J. 1994. “Business Computing Research Journals: A Normalized Citation Analysis,” *Journal of Management Information Systems* (11:1), pp. 131–140.
Hood, W., and Wilson, C. 2001. “The Literature of Bibliometrics, Scientometrics, and Informetrics,” *Scientometrics* (52:2), pp. 291–314.
Hsiao, C. H., and Yang, C. 2011. “The intellectual development of the technology acceptance model: A co-citation analysis,” *International Journal of Information Management* (31:2), pp. 128–136.
Jaccard, P. 1912. “The distribution of the flora in the apline zone 1,” *New Phytologist* (11:2), pp. 37–50.
Jennings, C. 1998. “Citation data: the wrong impact?: the wrong impact?” *nature neuroscience* (1:8), pp. 641–642.
Katerattanakul, P., and Han, B. 2003. “Are European IS Journals under-rated?: An answer based on citation analysis,” *European Journal of Information Systems* (12:1), pp. 60–71.
Kessler, M. M. 1963. “Bibliographic coupling between scientific papers,” *American Documentation* (14:1), pp. 10–25.
Kim, H., and Barnett, G. 2008. “Social Network Analysis Using Author Co-Citation Data,” in *AMCIS 2008 Proceedings*, Toronto, Ontario, Canada. August 14-17.
Lang, T., Hall, D., and Landrum, W. H. 2010. “Citation Analysis and Trends in Knowledge Management,” in *AMCIS 2010 Proceedings*, Lima, Peru. August 12-15.
Levy, Y., and Ellis, T. 2006. “A Systems Approach to Conduct an Effective Literature Review in Support of Information Systems Research,” *Informing Science Journal* (9), pp. 181–212.

Li, X., Chen, H., Zhang, Z., Li, J., and Nunamaker, J. F. 2009. "Managing Knowledge in Light of Its Evolution Process: An Empirical Study on Citation Network-Based Patent Classification," *Journal of Management Information Systems* (26:1), pp. 129–154.

Liu, Y., Li, H., Goncalves, J., Kostakos, V., and Xiao, B. 2016. "Fragmentation or cohesion?: Visualizing the process and consequences of information system diversity, 1993–2012," *European Journal of Information Systems* .

Lotka, A. J. 1926. "The frequency distribution of scientific productivity," *Journal of the Franklin Institute* (202:2), p. 271.

Lowry, P., Moody, G., Gaskin, J., Galletta, D., Humpherys, S., and Barlow, J. 2013. "Evaluating Journal Quality and the Association for Information Systems Senior Scholars' Journal Basekt via Bibliometric Measures: Do Expert Journals Assessment add Value?" *MIS Quarterly* (37:4), pp. 993–1012.

Lowry, P., Romans, D., and Curtis, A. 2004. "Global Journal Prestige and Supporting Disciplines: A Scientometric Study of Information Systems Journals," *Journal of the Association for Information Systems* (5:2), pp. 29–77.

Mingers, J., and Harzing, A.-W. 2007. "Ranking journals in business and management: A statistical analysis of the Harzing data set," *European Journal of Information Systems* (16:S4), pp. 303–316.

Mingers, J., and Leydesdorff, L. 2014. "Identifying research fields within business and management: A journal cross-citation analysis," *Journal of the Operational Research Society* (66:8), pp. 1370–1384.

Mingers, J., and Leydesdorff, L. 2015. "A review of theory and practice in scientometrics," *European Journal of Operational Research* (246:1), pp. 1–19.

Moody, D., Iacob, M.-E., and Amrit, C. 2010. "In Search of Paradigms: Identifying the Theoretical Foundations of the IS Field," in *Proceedings ECIS 2010*, P. Alexander, M. Turpin and J. van Deventer (eds.).

Murtagh, F., and Contreras, P. 2012. "Algorithms for hierarchical clustering: An overview," *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery* (2:1), pp. 86–97.

Nerur, S., Sikora, R., Mangalaraj, G., and Balijepally, V. 2005. "Assessing the relative influence of journals in a citation network," *Communications of the ACM* (48:11), pp. 71–74.

Oh, W., Choi, J., and Kim, K. 2006. "Coauthorship Dynamics and Knowledge Capital: The Patterns of Cross-Disciplinary Collaboration in Information Systems Research," *Journal of Management Information Systems* (22:3), pp. 266–292.

Pilkington, A., and Meredith, J. 2009. "The evolution of the intellectual structure of operations management—1980–2006: A citation/co-citation analysis," *Journal of Operations Management* (27:3), pp. 185–202.

Polites, G., and Watson, R. 2009. "Using Social Network Analysis to Analyze Relationships Among IS Journals," *Journal of the Association for Information Systems* (10:08), pp. 595–636.

Porch, C., Timbrell, G., and Rosemann, M. 2015. "Platforms: A Systematic Review Of The Literature Using Algorithmic Historiography," in *ECIS 2015 Proceedings*: *23rd European Conference on Information Systems*, J. Becker, J. vom Brocke and M. de Marco (eds.), Münster, Germany. May 26-29.

Pritschard, A. 1969. "Statistical Bibliography or Bibliometrics?" *Journal of Documentation* (25:4), pp. 348–349.

Raghuram, S., Tuertscher, P., and Garud, R. 2010. "Research Note —Mapping the Field of Virtual Work: A Cocitation Analysis," *Information Systems Research* (21:4), pp. 983–999.

Rainer, R. K., and Miller, M. D. 2005. "Examining differences across journal rankings," *Communications of the ACM* (48:2), pp. 91–94.

Renaud, A., Walsh, I., and Kalika, M. 2016. "Is SAM still alive?: A bibliometric and interpretive mapping of the strategic alignment research field," *The Journal of Strategic Information Systems* (25:2), pp. 75–103.

Renauld, A., Walsh, I., and Kalika, M. 2012. "An Examination of the Strategic Alignment Literature in IS through a Co-Citation Analysis," in *AMCIS 2012 Proceedings*, Seattle, Washington, USA. August 9-11.

Rogers, D. J., and Tanimoto, T. T. 1960. "A Computer Program for Classifying Plants," *Science* (132:3434), pp. 1115–1118.

Sadiq, S., Yeganeh, K., and Indulska, M. 2011. "Cross-Disciplinary Collaborations in Data Quality Research," in *ECIS 2011 Proceedings*, V. Tuunainen, M. Rossi and J. Nandhakumar (eds.), Helsinki, Finland. June 9-11.

Seglen, P. 1997. "Why the impact factor of journals should not be used for evaluating research," *British Medical Journal* (314:7079), pp. 498–502.

Serenko, A., Bontis, N., Booker, L., Sadeddin, K., and Hardie, T. 2010. "A scientometric analysis of knowledge management and intellectual capital academic literature (1994-2008)," *Journal of Knowledge Management* (14:1), pp. 3–23.

Serenko, A., Cox, R. A., Bontis, N., and Booker, L. D. 2011. "The superstar phenomenon in the knowledge management and intellectual capital academic discipline," *Journal of Informetrics* .

Shiau, W.-L., Lin Bang-Wen, and Yan, C.-M. 2016. "The Intellectual Core Knowledge of the Mobile Information System," in *PACIS 2016*, T.-P. Liang, S.-Y. Hung, P. Chau and S.-I. Chang (eds.), Chiayi, Taiwan. June 27 - July 1.

Sidiropoulos, A., Katsaros, D., and Manolopoulos, Y. 2007. "Generalized Hirsch h-index for disclosing latent facts in citation networks," *Scientometrics* (72:2), pp. 253–280.

Small, H. 1973. "Co-citation in the Scientific Literature: A New Measure of the Relationship Between Two Documents," *Journal of the American Society for Information Science* (24:4), pp. 265–269.

Stein, M.-K., Galliers, R., and Whitley, E. A. 2016. "Twenty years of the European information systems academy at ECIS: emergent trends and research topics," *European Journal of Information Systems* (25:1).

Takeda, H., Cuellar, M., Truex III, D., and Vidgen, R. 2011. "Networks of Innovation in IS Research: An Exploartion of the Relationship between Co-authorship networks and h-family indices," in *ECIS 2011 Proceedings*, V. Tuunainen, M. Rossi and J. Nandhakumar (eds.), Helsinki, Finland. June 9-11.

Takeda, H., Truex III, D., and Cuellar, M. 2010. "Evaluating Scholarly Influence Through Social Network Analysis: The Next Step in Evaluating Scholarly Influence," in *AMCIS 2010 Proceedings*, Lima, Peru. August 12-15.

Truex III, D., Cuellar, M., and Takeda, H. 2008. "Assessing Scholarly Influence: Proposing New Metrics," in *ICIS 2008 Proceedings*.

Truex III, D., Cuellar, M., Takeda, H., and Vidgen, R. 2011. "The scholarly influence of Heinz Klein: Ideational and social measures of his impact on IS research and IS scholars," *European Journal of Information Systems* (20:4), pp. 422–439.

Truex III, D., Takeda, H., and Cuellar, M. 2009. "Assessing Scholarly Influence: Using the Hirsch Indices to Reframe the Discourse," *Journal of the Association for Information Systems* (10:7), pp. 560–594.

van Noorden, R. 2014. "Publishers withdraw more than 120 gibberish papers," *Nature* .

vom Brocke, J., Simons, A., Niehaves, B., Reimer, K., Plattfaut, R., and Cleven, A. 2009. "Reconstructing the giant: On the importance of rigour in documenting the literature search process," in *ECIS 2009 Proceedings*, S. Newell, E. A. Whitley, N. Pouloudi, J. Wareham and L. Mathiassen (eds.), Verona, Italy, pp. 2206–2217.

Wade, M., Biehl, M., and Kim, H. 2006a. "If the Tree of IS Knowledge Falls in a Forest, Will Anyone Hear?: A Commentary on Grover et al.," *Journal of the Association for Information Systems* (7:5), pp. 326–335.

Wade, M., Biehl, M., and Kim, H. 2006b. "Informaiton Systens is Not a Reference Discipline: And Waht We Can Do About It," *Journal of the Association for Information Systems* (7:5), pp. 247–269.

Walstrom, K., and Leonard, L. 2000. "Citation classics from the information systems literature," *Information & Management* (38:2), pp. 59–72.

Wang, N., Liang, H., Jia, Y., Ge, S., Xue, Y., and Wang, Z. 2016. "Cloud computing research in the IS discipline: A citation/co-citation analysis," *Decision Support Systems* (86), pp. 35–47.

Wasserman, S., and Faust, K. 1994. *Social network analysis*: *Methods and applications*, Cambridge u.a.: Cambridge Univ. Press.

Webster, J., and Watson, R. 2002. "Analyzing the Past to Prepare for the Future: Writing a Literature Review," *MIS Quarterly* (26:2), pp. xiii–xxiii.

Yang, K.-C., Huang, C.-H., Yang, C., and Tu, Y.-N. 2016. "A Study of Information System Success Model in MIS: By Author co-citation Analysis," in *PACIS 2016*, T.-P. Liang, S.-Y. Hung, P. Chau and S.-I. Chang (eds.), Chiayi, Taiwan. June 27 - July 1.

Zhang, C.-T. 2009. "The e-index, complementing the h-index for excess citations," *PloS one* (4:5), e5429.

Zitt, M. 2015. "Meso-level retrieval: IR-bibliometrics interplay and hybrid citation-words methods in scientific fields delineation," *Scientometrics* (102:3), pp. 2223–2245.

Zupic, I., and Cater, T. 2015. "Bibliometric Methods in Management and Organization," *Organizational Research Methods* (18:3), pp. 429–472.

Appendix

List of studies

Bernroider, E. W. N., Pilkington, A., and Córdoba, J.-R. 2013. "Research in information systems: A study of diversity and inter-disciplinary discourse in the AIS basket journals between 1995 and 2011," Journal of Information Technology (28:1), pp. 74–89.

Beverungen, D. 2011. "Mapping the Emerging Field of Service Science: Insights from a Citation Network and Cocitation Network Analysis," in ICIS 2011 Proceedings, D. Galletta and T.-P. Liang (eds.), Shanghai, China. December 4-7.

Bontis, N., and Serenko, A. 2009. "A follow-up ranking of academic journals," Journal of Knowledge Management (13:1), pp. 16–26.

Charvet, F., Cooper, M., and Gardner, J. 2008. "The Intellectual Structure of Supply Chain Management: A Bibliometric Approach," Journal of Business Logistics (27:1), 47-73.

Chen, L., and Holsapple, C. 2013. "Impact Analysis in E-Business: A Case of Adoption Research," in AMCIS 2013 Proceedings, Chicago, Illinois, USA. August 15-17.

Cooper, R., Blair, D., and Pao, M. 1993. "Communicating MIS Research: A Citation Study of Journal Influence," Information Processing & Management (29:1), pp. 113–127.

Córdoba, J.-R., Pilkington, A., and Bernroider, E. W. N. 2012. "Information systems as a discipline in the making: Comparing EJIS and MISQ between 1995 and 2008," European Journal of Information Systems (21:5), pp. 479–495.

Cuellar, M., Takeda, H., and Truex III, D. 2008. "The Hirsch Family of Bibliometric Indices as an Improved Measure of IS Academic Journal Impact," in AMCIS 2008 Proceedings, Toronto, Ontario, Canada. August 14-17.

Cuellar, M., Takeda, H., Vidgen, R., and Truex III, D. 2016. "Ideational Influence, Connectedness, and Venue Representation: Making an Assessment of Scholarly Capital," Journal of the Association for Information Systems (17:1), pp. 1–28.

Culnan, M. 1986. "The Intellectual Development of Management Information Systems, 1972-1982: A co-citation analysis," Management Science (32:2).

Culnan, M. 1987. "Mapping the Intellectual Structure of MIS, 1980-1985: A Co-Citation Analysis," MIS Quarterly (11:3), p. 341.

Culnan, M., and Swanson, B. 1986. "Researchin Management Information Systems, 1980-1984: Points of Work and Reference," MIS Quarterly (10:3), pp. 289–302.

DuBois, F., and Reeb, D. 2000. "Ranking the International Business Journals," Journal of International Business Studies (31:4), pp. 689–704.

Dwivedi, Y. K., and Kuljis, J. 2008. "Profile of IS research published in the European Journal of Information Systems," European Journal of Information Systems (17:6), pp. 678–693.

Dwivedi, Y. K., Mustafee, N., Carter, L., and Williams, M. 2010. "A Bibliometric Comparision of the Usage of Two Theories of IS/IT Acceptance (TAM and UTAUT)," in AMCIS 2010 Proceedings, Lima, Peru. August 12-15.

Eom, S. B. 1996. "Mapping the intellectual structure of research in decision support systems through author cocitation analysis (1971–1993)," Decision Support Systems (16:4), pp. 315–338.

Eom, S. B., and Farris, R. 1996. "The contributions of organizational science to the development of decision support systems research subspecialties," Journal of the American Society for Information Science (47:12), pp. 941–952.

Eom, S. B., Lee, S. M., and Kim, J. K. 1993. "The intellectual structure of decision support systems (1971–1989)," Decision Support Systems (10:1), pp. 19–35.

Everett, J., and Pecotich, A. 1991. "A Combined Loglinear/MDS Model for Mapping Journals by Citation Analysis," Journal of the American Society for Information Science (42:6), pp. 405–413.

Fischer, C. 2011. "The Information Systems Design Science Research Body Of Knowledge: A Citation Analysis In Recent Top-Journal Publications," in PACIS 2011: Quality Research in Pacific Asia, P. Seddon and S. Gregor (eds.), Brisbane, Australia. 7-11 July.

Forgionne, G. A., and Kohli, R. 2001. "A multiple criteria assessment of decision technology system journal quality," Information & Management (38:7), pp. 421–435.

Gallivan, M., and Ahuja, M. 2015. "Co-authorship, Homophily, and Scholarly Influence in Information Systems Research," Journal of the Association for Information Systems (16:12), pp. 980–1015.

Gallivan, M., and Tao, Y. 2014. "The Value of Co-Citation Analysis for Understanding a Field's Intellectual Structure: An Application to Healthcare Information Technology (HIT) Research," in AMCIS 2014 Proceedings, Savannah, Georgia, USA. August 7-9.

Grover, V., Ayyagari, R., Gokhale, R., Lim, J., and Coffey, J. 2006. "A Citation Analysis of the Evolution and State of Information Systems within a Constellation of Reference Disciplines," Journal of the Association for Information Systems (7:5), pp. 270–325.

Hamilton, S., and Ives, B. 1982. "Knowledge Utilization among MIS Researchers," MIS Quarterly (6:4), p. 61.

Hansen, S., Lyytinen, K., and Markus, L. 2006. "The Legacy of "Power and Politics" in Disciplinary Discourse: A Citation Analysis," in ICIS 2006 Proceedings.

Holsapple, C., Johnson, E., Manakyan, H., and Tanner, J. 1994. "Business Computing Research Journals: A Normalized Citation Analysis," Journal of Management Information Systems (11:1), pp. 131–140.

Hsiao, C. H., and Yang, C. 2011. "The intellectual development of the technology acceptance model: A co-citation analysis," International Journal of Information Management (31:2), pp. 128–136.

Hsu, F.-M., Lin, C.-M., Fang, C.-T., Chiu, C.-M., and Chen, P.-H. 2014. "The Intellectual Structure of Electronic Records Management," in PACIS 2014 Proceedings, K. Siau, Q. Li and X. Guo (eds.), Chengdu, China. June 24-28.

Katerattanakul, P., and Han, B. 2003. "Are European IS Journals under-rated?: An answer based on citation analysis," European Journal of Information Systems (12:1), pp. 60–71.

Katerattanakul, P., Han, B., and Rea, A. 2006. "Is information systems a reference discipline?" Communications of the ACM (49:5), pp. 114–118.

Kim, H., and Barnett, G. 2008. "Social Network Analysis Using Author Co-Citation Data," in AMCIS 2008 Proceedings, Toronto, Ontario, Canada. August 14-17.

Lang, T., Hall, D., and Landrum, W. H. 2010. "Citation Analysis and Trends in Knowledge Management," in AMCIS 2010 Proceedings, Lima, Peru. August 12-15.

Lowry, P., Karuga, G., and Richardson, V. 2007. "Assessing Leading Institions, Faculaty, and Articles in Permier Informaiton Systems Research Journals," Communications of the Association for Information Systems (20:16), pp. 142–203.

Lowry, P., Moody, G., Gaskin, J., Galletta, D., Humpherys, S., and Barlow, J. 2013. "Evaluating Journal Quality and the Association for Information Systems Senior Scholars' Journal Basekt via Bibliometric Measures: Do Expert Journals Assessment add Value?" MIS Quarterly (37:4), pp. 993–1012.

Mingers, J., and Leydesdorff, L. 2014. "Identifying research fields within business and management: A journal cross-citation analysis," Journal of the Operational Research Society (66:8), pp. 1370–1384.

Moody, D., Iacob, M.-E., and Amrit, C. 2010. "In Search of Paradigms: Identifying the Theoretical Foundations of the IS Field," in Proceedings ECIS 2010, P. Alexander, M. Turpin and J. van Deventer (eds.).

Nerur, S., Mahapatra, R., Balijepally, V., and Mangalaraj, G. 2006. "Is Information Systems a Reference Discipline?" in Proceedings of the 39th Annual Hawaii International Conference on System Sciences: 4 - 7 January 2006, Kauai, Hawaii ; abstracts and CD-ROM of full papers, R. H. Sprague (ed.), Los Alamitos, Calif.: IEEE Computer Society.

Nerur, S., Sikora, R., Mangalaraj, G., and Balijepally, V. 2005. "Assessing the relative influence of journals in a citation network," Communications of the ACM (48:11), pp. 71–74.

Oh, W., Choi, J., and Kim, K. 2006. "Coauthorship Dynamics and Knowledge Capital: The Patterns of Cross-Disciplinary Collaboration in Information Systems Research," Journal of Management Information Systems (22:3), pp. 266–292.

Pilkington, A., and Meredith, J. 2009. "The evolution of the intellectual structure of operations management—1980–2006: A citation/co-citation analysis," Journal of Operations Management (27:3), pp. 185–202.

Polites, G., and Watson, R. 2009. "Using Social Network Analysis to Analyze Relationships Among IS Journals," Journal of the Association for Information Systems (10:08), pp. 595–636.

Porch, C., Timbrell, G., and Rosemann, M. 2015. "Platforms: A Systematic Review Of The Literature Using Algorithmic Historiography," in ECIS 2015 Proceedings: 23rd European Conference on Information Systems, J. Becker, J. vom Brocke and M. de Marco (eds.), Münster, Germany. May 26-29.

Raghuram, S., Tuertscher, P., and Garud, R. 2010. "Research Note —Mapping the Field of Virtual Work: A Cocitation Analysis," Information Systems Research (21:4), pp. 983–999.

Renaud, A., Walsh, I., and Kalika, M. 2016. "Is SAM still alive?: A bibliometric and interpretive mapping of the strategic alignment research field," The Journal of Strategic Information Systems (25:2), pp. 75–103.

Sadiq, S., Yeganeh, K., and Indulska, M. 2011. "Cross-Disciplinary Collaborations in Data Quality Research," in ECIS 2011 Proceedings, V. Tuunainen, M. Rossi and J. Nandhakumar (eds.), Helsinki, Finland. June 9-11.

Serenko, A., Bontis, N., Booker, L., Sadeddin, K., and Hardie, T. 2010. "A scientometric analysis of knowledge management and intellectual capital academic literature (1994-2008)," Journal of Knowledge Management (14:1), pp. 3–23.

Serenko, A., Bontis, N., and Moshonsky, M. 2011. "Exploring the Role of Books as a Knowledge Translation Mechanism: Citation Analysis and Author Survey," in AMCIS 2011 Proceedings, Detroit, Michigan, USA. August 4-8.

Serenko, A., Cox, R. A., Bontis, N., and Booker, L. D. 2011. "The superstar phenomenon in the knowledge management and intellectual capital academic discipline," Journal of Informetrics .

Shiau, W.-L., and Kang, S.-W. 2011. "The Intellectual Core Of Electronic Commerce Research From 2006 To 2010," in PACIS 2011: Quality Research in Pacific Asia, P. Seddon and S. Gregor (eds.), Brisbane, Australia. 7-11 July.

Shiau, W.-L., Lin Bang-Wen, and Yan, C.-M. 2016. "The Intellectual Core Knowledge of the Mobile Information System," in PACIS 2016, T.-P. Liang, S.-Y. Hung, P. Chau and S.-I. Chang (eds.), Chiayi, Taiwan. June 27 - July 1.

Sircar, S., Nerur, S., and Mahapatra, R. 2001. "Revolution or Evolution?: A Comparison of Object-Oriented and Structured Systems Development Methods," MIS Quarterly (25:4), pp. 457–471.

Stein, M.-K., Galliers, R., and Whitley, E. A. 2016. "Twenty years of the European information systems academy at ECIS: emergent trends and research topics," European Journal of Information Systems (25:1).

Takeda, H., Cuellar, M., Truex III, D., and Vidgen, R. 2011. "Networks of Innovation in IS Research: An Exploartion of the Relationship between Co-authorship networks and h-family indices," in ECIS 2011 Proceedings, V. Tuunainen, M. Rossi and J. Nandhakumar (eds.), Helsinki, Finland. June 9-11.

Takeda, H., Truex III, D., and Cuellar, M. 2010. "Evaluating Scholarly Influence Through Social Network Analysis: The Next Step in Evaluating Scholarly Influence," in AMCIS 2010 Proceedings, Lima, Peru. August 12-15.

Tang, X., Wang, L., and Kishore, R. 2014. "Why Do IS Scholars Cite Other Scholars?: An Empirical Analysis of the Direct and Moderating Effects of Cooperation and Competition among IS Scholars on Individual Citation Behavior," in ICIS 2014 Proceedings, M. Myers and D. Straub (eds.), Auckland, New Zealand. December 14-17.

Taylor, H., Dillon, S., and van Wingen, M. 2010. "Focus and Diversity in Information Systems Research: Meeting the Dual Demands of a Healthy Applied Discipline," MIS Quarterly (34:4), pp. 647–667.

Truex III, D., Cuellar, M., and Takeda, H. 2008. "Assessing Scholarly Influence: Proposing New Metrics," in ICIS 2008 Proceedings.

Truex III, D., Cuellar, M., Takeda, H., and Vidgen, R. 2011. "The scholarly influence of Heinz Klein: Ideational and social measures of his impact on IS research and IS scholars," European Journal of Information Systems (20:4), pp. 422–439.

Truex III, D., Takeda, H., and Cuellar, M. 2009. "Assessing Scholarly Influence: Using the Hirsch Indices to Reframe the Discourse," Journal of the Association for Information Systems (10:7), pp. 560–594.

Wade, M., Biehl, M., and Kim, H. 2006. "Informaiton Systens is Not a Reference Discipline: And Waht We Can Do About It," Journal of the Association for Information Systems (7:5), pp. 247–269.

Walstrom, K., and Leonard, L. 2000. "Citation classics from the information systems literature," Information & Management (38:2), pp. 59–72.

Wang, N., Liang, H., Jia, Y., Ge, S., Xue, Y., and Wang, Z. 2016. "Cloud computing research in the IS discipline: A citation/co-citation analysis," Decision Support Systems (86), pp. 35–47.

Whitley, E. A., and Galliers, R. D. 2007. "An alternative perspective on citation classics: Evidence from the first 10 years of the European Conference on Information Systems," Information & Management (44:5), pp. 441–455.

Xiao, B., Cheung, C., and Thadani, D. 2011. "Assessing the Quality and Knowledge Contribution of Top IS Journals: A Comparative Citation Analysis," in ECIS 2011 Proceedings, V. Tuunainen, M. Rossi and J. Nandhakumar (eds.), Helsinki, Finland. June 9-11.

Yang, K.-C., Huang, C.-H., Yang, C., and Tu, Y.-N. 2016. "A Study of Information System Success Model in MIS: By Author co-citation Analysis," in PACIS 2016, T.-P. Liang, S.-Y. Hung, P. Chau and S.-I. Chang (eds.), Chiayi, Taiwan. June 27 - July 1.