

A bibliometric overview of how critical success factors influence on enterprise resource planning implementations

Pau Vicedo*, Hermenegildo Gil, Raúl Oltra-Badenes and Vicente Guerola-Navarro
Department of Business Organization, Universitat Politècnica de València, Camí de Vera s/n, 46022 València, Spain

Abstract. This work conducts bibliometric research into publications during the period 1999 to early 2018. The aim of this study is to help gain a better understanding of the publications covering CSF and ERP implementations all over the world. The study includes the most cited articles, most cited authors and most influential institutions as well as the most prolific countries. A database of 301 articles from 86 different institutions and 48 countries has been documented and analyzed. The results indicate that this field is growing significantly over time and a small number of US institutions are currently the most productive in this field.

Keywords: CSF, ERP, bibliometrics, Web of Science

1. Introduction

The process of digitalization and globalization means that companies now have to make faster decisions in order to survive. Small and Medium-sized Enterprises (SMEs) have found in Enterprise Resource Planning Systems (ERP) a key tool to adapt to this dynamic scenario. ERP systems provide real-time information about the company, such as planning, production and customer response among others. These systems are revolutionizing the organizations [1], and they are the main reference for decision making and to quickly adapt to market changes. However, it is not enough to implement an ERP within a company to accomplish the goals, if the company wants to survive or grow. Many of the implementations have been classified as failures because they did not achieve predetermined corporate goals. There are several factors that can lead to success or failure [2], and these factors, known as Critical Success Factors (CSF), are defined as a necessary fact or element to achieve a particular goal. Therefore, CSFs are a crucial element to successfully implement ERPs, and

thus it is crucial to ensure that they are identified and correctly dealt with.

Bibliometrics is defined by [3] as the discipline that studies bibliographic material quantitatively. There are many bibliometric studies in the literature mainly focused on analysis of specific Journals [22] [23] [24] [25] [27] [28] [29] [30] [31] [32] [33] [34] [35] [37] [38] [39] [40] and [41]. Much of this work also looks at research fields such as innovation [43], research disciplines [36] and management sciences [26]. Among them the reader can find a number of different approaches. For example, [21] and [23] presented an analysis of influential countries based on number of studies cited. Several studies, such as [29] use thresholds to better identify the impact of each study, and they generally cover between over 100, 50, 20, 10, 5 and 1 citations. [31] also relates the population of the countries and the number of citations to identify which are the most productive countries and [32] introduces de *h-index*, while [22], [23] and [33] introduce co-citation including document co-citation, author co-citation and institute co-citation. It is also worth highlighting that [22], [23] and [30] also use

*Corresponding author. E-mail: pavipa@upv.es

VOS Viewer software for graphical representation of the bibliometric results.

It is important to highlight that all of the above cited articles use the Web of Science as a core database to analyze bibliometric data.

Starting from their inception, ERP systems and their CSFs for successful implementation have produced a substantial number of published research papers ongoing studies [13]. The aim of this work is to synthesize the existing scientific bibliography into a bibliometric study, from a general perspective regarding leading institutions, authors, journals, countries and the most cited articles, all of which use indexes that help to provide a better understanding of the state of the art and also to highlight trends in the field of study. This study was motivated by a number of different factors. Firstly, the aim was to provide value in a field where there is not yet a large number of studies but which is in continuous growth due to business evolution and digitization. Secondly, this work aims to help researchers and authors to find the most influential actors, whether they be authors, countries or institutions, in the field that might help them to focus their research in a more effective way. Finally, it is necessary to identify which journals publish more on this type of article and their influence.

The authors believe that interest on this work will grow as the reader sees the evolution in the number of published articles within the last 18 years (Fig. 1). It is clear that interest and research in the field are growing. It is also hoped that the characterization of the CSF for ERP implementation publications provided in this article will serve as a basis for future, more extensive research, such as other articles or PhD research.

The main database in scientific research contributions is the Web of Science (WoS) which is the core of this work, however, WoS is a live database which is continuously growing and adding more publications, and for this reason only existing publications from between 1999 and January 2018 have been considered. This study provides an overview of the evolution of the studies published over this period, the 50 most cited papers, the most influential universities and authors, the journals publishing in this field and,

finally, the most productive countries, considering both citations and publications. Prior to the results there is a section describing the methods used and following this, the conclusions are presented.

2. Methods

Studying and reviewing the literature on a specific topic gives an overview of research trends and its impact on the field [9] [17]. The current study considered all the publications over the years published on Web of Science (WoS), however only articles and reviews since 1999 have been found and only published studies during complete natural years have been considered. Although, there are other Academic databases, such as Google Scholar and Scopus, WoS is generally considered to be the best academic database on research contributions [20]. It contains more than 15,000 journals, over 90,000,000 records and covers up to 273 disciplines.

In bibliometric studies [19] [10] [14] a wide variety of methods are used but the most common indicators are the number of citations and the amount of publications. In this study, those two indicators were considered together with the H-index, a new index introduced by Hirsch [4], which integrates publications and citations into one single index. Other indexes were also considered in order to define the impact of each article [18], the ratio (citations / articles), and for each institution the ratio (times cited / total studies). Moreover, as [5] stated, the number of articles above a citation threshold allows the researcher to identify influential articles, which is why different thresholds are considered in the results. Additionally, it is important to identify the quality of the institution [15] because this indicates the importance and impact of an article. For this reason, the reputed Academic Ranking of World Universities [5] and the QS World University Rankings [6] were consulted to identify the quality of the institution. Finally, a study on which journals [16] publish work on this topic was conducted to complete the picture regarding the state of the art.

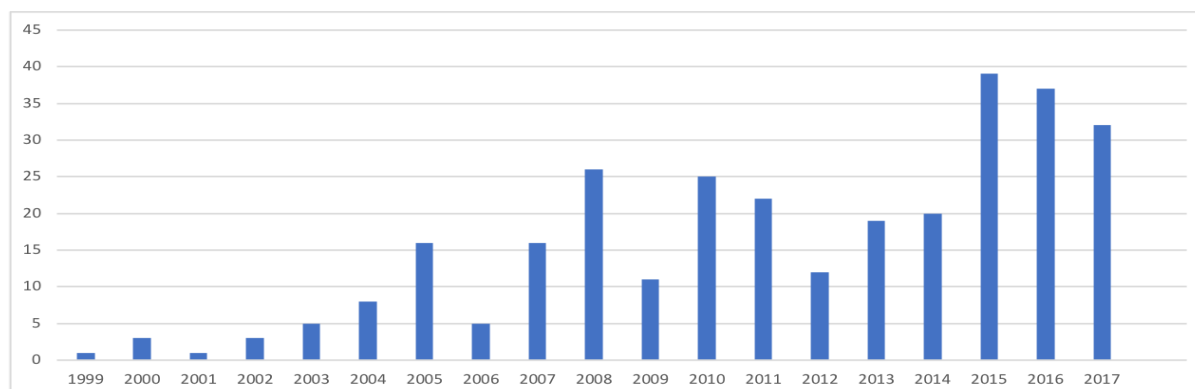


Fig 1. Number of studies published per year

When conducting the study some limitations were applied in order to narrow the results to the specific field of study. Therefore, a selection of keywords related to the topic was done. The keywords considered are: ERP, CSF, Enterprise Resource(s) Planning, Critical Success Factor(s) and Enterprise System(s). This generated 549 references not all of which were related to the main topic, consequently not all categories have been taken into account, only those within the field of study: computer science information systems, management, information science library science, operations research management science, computer science interdisciplinary applications, business, engineering industrial, computer science theory methods, engineering manufacturing, computer science artificial intelligence, engineering electrical electronic, economics, computer science software engineering, engineering multidisciplinary, business finance, computer science hardware architecture, telecommunications, social sciences interdisciplinary, computer science cybernetics, automation control systems, planning development, engineering mechanical and ergonomics reducing the amount of publications to 491 and then only the article (287 papers) and reviews (15) were taken, leaving a final total of 301 research works. The study used the material available on WoS in January 2018.

For a better result understanding, this article also includes a graphical analysis of the bibliographic material by using the VOS Viewer software [42]. This software draws maps based on the collected data from WoS based on citation and co-citation, coupling and co-authorship among others [22].

3. Results

In this section the most significant results of the bibliometric analysis are presented. Following the

indicated keywords and related categories of study, 491 references were found including 287 articles, 17 book chapters, 199 proceedings papers, 15 reviews, 2 editorial materials and 1 book. These works have a total number of citations of 8999 with a ratio (cites / studies) of 18.33, the h-index is 44.

In order to narrow the results only the articles and reviews have been considered making a total of 301 references, since these options are the ones which can be considered as pure scientific contributions. Thus 8817 citations with a ratio (cites / studies) of 29.29 and a h-index of 44 were obtained.

3.1. Evolution of published studies

The first study found was published in 1999, and was the only one published that year. As can be seen in Fig. 1 the number of studies increased slowly up to a total of 24 in 2008 with the exception of 2006 where only 5 studies were published. After 4 years of decreasing number of publications, they increased again, until reaching their maximum during the years 2015 and 2016 with 35 publications followed by a minor decline in 2017. The gradual increase of publications it is due to two main factors, the first of which is the increase in researchers worldwide and the second and main reason is the digitalization of society. Increasingly, it is clear that companies need more up-to-date information to make decisions faster and to be able to adapt to the market changes, and it is here that ERP systems gain relevance as the scientific community gains awareness of how the world is evolving.

Analyzing the citations in Table 1. General citations per year, it can be seen that the most cited articles are not the ones published more recently. The year 2007 was the year with the most citations with 1464, other years with more than 1000 citations were 2003, 2005 and 2008. This is not related to the num-

ber of articles published which increase almost every year.

3.2. 50 most cited papers published

Table 1. General citation per year

Year	≥100	≥50	≥20	≥10	≥5	≥1	TS	TC
1999	1	0	0	0	0	0	1	351
2000	1	1	0	0	0	1	3	243
2001	0	0	1	0	0	0	1	35
2002	2	1	0	0	0	0	3	776
2003	3	0	0	1	1	0	5	1009
2004	3	2	2	0	0	0	8	725
2005	4	4	3	1	1	2	16	1120
2006	1	1	1	2	0	0	5	243
2007	3	2	5	4	1	0	16	1470
2008	2	4	13	4	0	3	26	1126
2009	0	2	4	0	4	0	11	288
2010	0	2	7	6	3	5	25	467
2011	0	0	3	4	2	9	22	188
2012	0	0	2	5	2	2	12	165
2013	0	2	2	6	4	3	19	263
2014	0	0	0	4	10	5	20	151
2015	0	0	1	0	8	21	39	126
2016	0	0	0	0	4	15	37	53
2017	0	0	0	0	1	8	32	18
Total	20	21	44	37	41	74	301	8817
%	6.64	6.69	14.62	12.29	13.62	24.58	100	

Abbreviations: ≥100 = Number of documents with equal or more than 100 citations; ≥50 = Number of documents with equal or more than 50 citations; ≥20 = Number of documents with equal or more than 20 citations; ≥10 = Number of documents with equal or more than 10 citations; ≥5 = Number of documents with equal or more than 5 citations; ≥1 = Number of documents with equal or more than 1 citations; TS = Total studies; TC = Total citations; PCT = Percentage.

It is important to know which were the most cited papers because this can define how influential they have been to others. Table 2 lists the most cited publications in descending order, it can be observed that the most cited article, Liang, Huigang; Saraf, Nilesh; Hu, Qing; et al. (2007), has 817 citations with an average of 74.27 citations per year. The second is Umble, EJ; Haft, RR; Umble, MM (2003) with 513 citations and average of 34.20 citations per year.

There are 20 publications with over 100 citations each, all but one of which is from the first decade of the century. Looking further to the rest of the list it can be also stated that, again, all of the publications are from the same decade but one, and it has to be mentioned that the least cited research work has a significant number with 42 citations.

Fig. 2 shows graphically, by using the VOS Viewer software, the map of citations between articles (A cites B and B cites A) with a minimum threshold of one hundred citations. This figure demonstrates in a straightforward way which are the most influential articles.

3.3. Most productive and influential institutions

Table 3 shows the 50 most productive institutions worldwide in this case the number of publications, times cited, h-index and the ratio (times cited / total studies) are considered together with the most relevant number of papers above the given thresholds 100, 50 and 20 and the current global ranking at both, Academic Ranking of World Universities (ARWU) and Quacquarelli Symonds QS World University Rankings [12]. This helps the reader to have an idea of the real influence of each university. The top influential Universities are Florida Atlantic University from United States, Wayne State University from United States, University of Manchester from United Kingdom, University of Nebraska Lincoln from United States and the City University of Hong Kong from China, all of them above 300 citations overall. Regarding production, the University of Pablo de Olavide from Spain is the first with 8 total papers and the highest h-index 6, which means they have 6 articles with at least 6 citations each. Following this are the University of Ljubljana from Slovenia with 7 studies and Ryerson University from Canada and national Central University from Taiwan with 6 papers each.

The universities from the United States are the most listed with 12 appearances followed by United Kingdom (which includes the works published under England, Scotland, Wales and Northern Ireland) with 7, Canada with 6, and Taiwan, Iran and China with 4 each. Even though the most listed institutions listed are from countries such as US, UK, Canada and Australia it can be stated that European and Asian Universities are increasing their work in this field. This is due to the rise of Asian universities which are committed to technology research and how to apply it to the business environment. However, most of the universities are from English speaking countries.

Looking at the ARWU, 6 institutions are in the top 100 but only 2 of them are in the top 50: University of Manchester in position 38 and University of Melbourne in position 39. There are 17 universities which are not even listed in the ranking. Regarding the QS ranking, only one, National University of Singapore, is in the top 20 and City University of Hong Kong, University of Manchester and University of Melbourne are in the top 50. Between the 50 and 100 positions there are 5 more universities. Therefore, it can be stated that only few of those considered to be the best universities worldwide are not publishing on this topic.

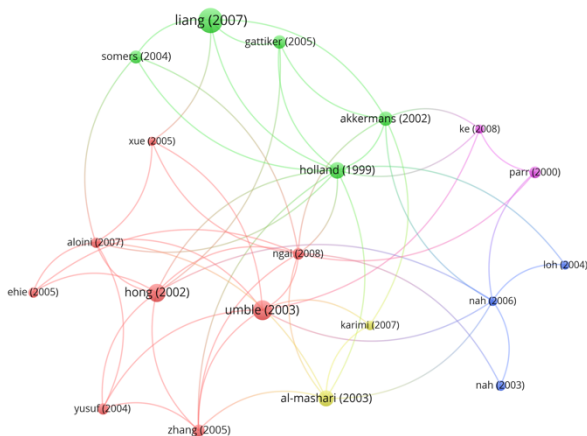


Fig 2. Citation between most influential articles

3.4. Most productive and influential authors

As with institutions, there are authors from around the world publishing about ERP and their CSFs for successful implementations. Table 4 presents the 50 most influential authors ordered by highest number of citations. As with the other sections, the h-index, the times cited, total studies and the ratio (cites / studies) appear to have been presented in order to get a better picture of their production and influence. Table 4 also includes the University/Institution where their last paper was submitted to the WoS and their country.

As shown in Table 4, Americans are the most cited authors with 8 out of the top 10, Liang and Xue share first position as they co-authored the most cited paper with 930. The first non-American author is the Chinese Law with 214 citations followed by the Spaniard Salmeron with 196, who is the most productive author with 7 published papers. English-speaking authors from US and UK occupy 18 of the top 22 places in the list emphasizing the importance of Anglo-Saxon countries in this field of research. Also noteworthy are the Spanish authors who have 3 places in the top 20, and among the most productive with a published number of papers and the University with more top authors are Ryerson University from Canada and Universidad Pablo de Olavide from Spain with three each.

3.5. Most productive and influential countries

WoS presents work from all around the world and, since the topic is general and not related to any geographical area, 48 countries are presented in Table 5. In this analysis the population in thousands [8] and the relationship between the total studies and cita-

tions to the inhabitants in millions to identify the productivity of each country have also been included. Furthermore, the same indexes as those used in the previous tables are used here as well. Note that the countries listed refer to the country where the author was working at the time of the publication.

As expected for the quality of their work, and already stated by the reviewed literature [21], the importance of their institutions and its size the US is the number one in terms of works (77) and times cited (4083) with an h-index of 29. The UK follows with 34 studies and 1613 citation with an h-index of 16. In 6th position we can find Taiwan with similar amount of works with 31 but less citations (568) which translates into that there is no relation to having a large amount of publications and being influential. Before Taiwan, there are UK, Canada, China and South Korea.

Nonetheless, the most productive country per inhabitant is Canada followed by Taiwan in second and UK in third position. It is worth highlighting that 4 out of the first 7 countries are English speaking countries and they represent over 51% of all studies. Asian countries, like China, South Korea and Taiwan, compete for the lead with the English-speaking countries. It is surprising that India, with great Universities and a large population, does not appear in the leading positions and is only stays in 26th place. On the other hand, the rest of the results are fairly diverse which shows that business digitalization is a global concern with several countries from Middle East, Europe, South Africa and Namibia from Africa and Colombia from South America.

3.6. Publishing Journals

In this section an overview of the journals [11] publishing in this field is given. Table 6 shows the journals with the highest number of publications on this field. At the top of the list is Enterprise Information Systems with 15 articles published, followed by International Journal of Production Economics with 14 and Computers in Industry and Journal of Computer Information Systems with 12.

On the other hand, the list varies when considering citations. In this case MIS Quarterly is first with 1143 citations followed by Information Management (965), European Journal of Operational Research (866), International Journal of Production Economics (864) and European Journal of Information Systems (473).

4. Conclusions

This study gives a general overview of the works published about ERP implementation and its CSFs on the WoS. The results show how the number of publications has increased over time from 1 in 1999 to more than 30 since 2015, and this has happened due to the continuous digitalization of the business world and the need for quality data in order to make faster decisions. The US leads the publications because they are home to the main universities but Asian countries follow closely. It is worth highlighting the importance of Taiwan in this field with its strong position and important number of publications and citations. In the following positions we see other English-speaking countries such as Australia, United Kingdom and Canada which leads the contributions per inhabitant. Not without cause, the most reputed institutions in this field belong to Taiwan, Spain, Canada, Slovenia and Hong Kong displacing American universities from the top. Developing countries do not appear in the leading positions but they are beginning to publish also in this field.

Regarding the journals, it is important to highlight that the most cited ones are not the most productive. The most cited article was published in *MIS Quarterly* which is one of the most important journals in the field. Moreover, the authors of that article, Liang and Xue, are also considered the most influential and their university, Florida Atlantic University, is also the first in institutions. Therefore, their article is considered the most important article with strongest impact on other research.

Observing the number of published studies and the citations generated, an objective view of the evolution that the research on this field has had during the last 18 years begins to emerge. I

It is worth noting that the work provides a general overview using a wide range of indicators including amount of publications, citations, h-index and several citation thresholds. This is due to the lack of an optimal standardized way of analyzing bibliometric results and, therefore, different research groups may be interested in different indicators considering different perspectives.

This article is intended to be the starting point for future research in the field of successful ERP implementations by delineating information sources.

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Table 2. The 50 most cited articles

R	TC	Title	Author/s	Year	C/Y
1	817	Assimilation of enterprise systems: The effect of institutional pressures and the mediating role of top management	Liang, Huigang; Saraf, Nilesh; Hu, Qing; et al.	2007	74,27
2	514	Enterprise resource planning: Implementation procedures and critical success factors	Umble, EJ; Haft, RR; Umble, MM	2003	34,27
3	434	The critical success factors for ERP implementation: an organizational fit perspective	Hong, KK; Kim, YG	2002	27,13
4	351	A critical success factors model for ERP implementation	Holland, CP; Light, B	1999	18,47
5	330	Enterprise resource planning: A taxonomy of critical factors	Al-Mashari, M; Al-Mudimigh, A; Zairi, M	2003	22,00
6	273	Vicious and virtuous cycles in ERP implementation: a case study of interrelations between critical success factors	Akkermans, H; van Helden, K	2002	17,06
7	240	What happens after ERP implementation: Understanding the impact of interdependence and differentiation on plant-level outcomes	Gattiker, TF; Goodhue, DL	2005	18,46
8	223	A taxonomy of players and activities across the ERP project life cycle	Somers, TM; Nelson, KG	2004	15,93
9	199	A framework of ERP systems implementation success in China: An empirical study	Zhang, Z; Lee, MKO; Huang, P; et al.	2005	15,31
10	184	A model of ERP project implementation	Parr, A; Shanks, G	2000	10,22
11	177	Examining the critical success factors in the adoption of enterprise resource planning	Ngai, E. W. T.; Law, C. C. H.; Wat, F. K. T.	2008	17,70
12	169	Enterprise information systems project implementation: A case study of ERP in Rolls-Royce	Yusuf, Y; Gunasekaran, A; Abthorpe, MS	2004	12,07
13	148	Identifying critical issues in enterprise resource planning (ERP) implementation	Ehie, IC; Madsen, M	2005	11,38
14	146	Risk management in ERP project introduction: Review of the literature	Aloini, Davide; Dulmin, Riccardo; Mininno, Valeria	2007	13,27
15	141	ERP implementation: Chief Information Officers' perceptions of critical success factors	Nah, FFF; Zuckweiler, KM; Lau, JLS	2003	9,40
16	119	The impact of ERP implementation on business process outcomes: A factor-based study	Karimi, Jahangir; Somers, Toni M.; Bhattacharjee, Anol	2007	10,82
17	117	Critical success factors for enterprise resource planning implementation and upgrade	Nah, Fiona Fui-Hoon; Delgado, Santiago	2006	9,75
18	113	Critical elements for a successful enterprise resource planning implementation in small- and medium-sized enterprises	Loh, TC; Koh, SCL	2004	8,07
19	109	ERP implementation failures in China: Case studies with implications for ERP vendors	Xue, YJ; Liang, HG; Boulton, WR; et al.	2005	8,38
20	105	Organizational culture and leadership in ERP implementation	Ke, Weiling; Wei, Kwok Kee	2008	10,50
21	91	Determinants of the adoption of enterprise resource planning within the technology-organization-environment framework: Taiwan's communications	Pan, Ming-Ju; Jang, Woan-Yuh	2008	9,10
22	84	Understanding success and failure in customer relationship management	King, Stephen F.; Burgess, Thomas F.	2008	8,40
23	82	A multi-project model of key factors affecting organizational benefits from enterprise systems	Seddon, Peter B.; Calvert, Cheryl; Yang, Song	2010	10,25
24	82	Perceived absorptive capacity of individual users in performance of Enterprise Resource Planning(ERP) usage: The case for Korean firms	Park, Jong-Hun; Suh, Hyun-Ju; Yang, Hee-Dong	2007	7,45
25	77	Achievement assessment for enterprise resource planning (ERP) system implementations based on critical success factors (CSFs)	Sun, AYT; Yazdani, A; Overend, JD	2005	5,92
26	76	Implications of the fit between organizational structure and ERP: A structural contingency theory perspective	Morton, Neil A.; Hu, Qing	2008	7,60
27	76	Causes influencing the effectiveness of the post-implementation ERP system	Yu, CS	2005	5,85
28	72	Successful use of e-procurement in supply chains	Puschmann, T	2005	5,54
29	70	Beyond critical success factors: A dynamic model of enterprise system innovation	King, SF; Burgess, TF	2006	5,83
30	69	The role of information systems resources in ERP capability building and business process outcomes	Karimi, Jahangir; Somers, Toni M.; Bhattacharjee, Anol	2007	6,18
31	69	Data quality issues in implementing an ERP	Xu, HJ; Nord, JH; Brown, N; et al.	2002	4,31
32	66	ERP implementation at SMEs: analysis of five Canadian cases	Snider, Brent; da Silveira, Giovanni J. C.; Balakrishnan, Jaydeep	2009	7,33
33	66	Improving productivity and firm performance with enterprise resource planning	Beheshü, Hooshang M.; Beheshü, Cyrus M.	2010	8,25
34	65	An integrative framework for the assimilation of enterprise resource planning systems: Phases, antecedents, and outcomes	Bajwa, DS; Garcia, JE; Mooney, T	2004	4,64
35	61	Successful enterprise resource planning implementation: taxonomy of critical factors	Dezdar, Shahin; Sulaiman, Ainin	2009	6,78
36	60	Aligning ERP implementation with competitive priorities of manufacturing firms: An exploratory study	Yen, HR; Sheu, C	2004	4,29
37	60	Investigating success factors in enterprise application integration: a case-driven analysis	Lam, W	2005	4,62
38	57	Enhancing manufacturing performance with ERP systems	Palaniswamy, R; Frank, T	2000	3,17
39	56	TAM-based success modeling in ERP	Bueno, Salvador; Salmeron, Jose L.	2013	11,20
40	55	A grey-based DEMATEL model for evaluating business process management critical success factors	Bai, Chunguang; Sarkis, Joseph	2013	11,00
41	51	Implementation critical success factors (CSFs) for ERP: Do they contribute to implementation success and post-implementation performance?	Ram, Jiwat; Corkindale, David; Wu, Ming-Lu	2013	10,20
42	49	Unleashing the effectiveness of process-oriented information systems: Problem analysis, critical success factors, and implications	Mutschler, Bela; Reichert, Manfred; Bumiller, Johannes	2008	4,90
43	45	The ERP challenge in China: a resource-based perspective	He, X	2004	3,21
44	44	Understanding misalignment and cascading change of ERP implementation: a stage view of process analysis	Wei, HL; Wang, ETG; Ju, PH	2005	3,38
45	43	Identification and classification of ERP critical failure factors in Iranian industries	Amid, Amin; Moalagh, Morteza; Ravasan, Ahad Zare	2012	7,17
46	43	TQM-A predecessor of ERP implementation	Li, Ling; Markowski, Carol; Xu, Li; et al.	2008	4,30
47	43	Fuzzy modeling Enterprise Resource Planning tool selection	Bueno, Salvador; Salmeron, Jose L.	2008	4,30
48	43	CIOs' perspectives of critical success factors in ERP upgrade projects	Olson, D. L.; Zhao, F.	2007	3,91
49	42	The role of organizational knowledge management in successful ERP implementation projects	Vandaie, Ramin	2008	4,20
50	42	ERP and SCM systems integration: The case of a valve manufacturer in China	Bose, Indrani; Pal, Raktim; Ye, Alex	2008	4,20

Abbreviations available in Table 1 except for R = Rank.

Table 3. Most productive and influential institutions

R	Institution	Country	TS	TC	H	TC/TS	≥ 100	≥ 50	≥ 20	ARWU	QS
1	Florida Atlantic U	US	3	1006	3	335,33	2	1	0	-	-
2	Wayne State U	US	4	415	4	103,75	2	1	0	301-400	461-470
3	U of Manchester	UK	2	382	2	191,00	1	0	1	38	34
4	U of Nebraska Lincoln	US	4	328	4	82,00	2	0	2	151-200	501-550
5	City U of Hong Kong	CN	5	310	3	62,00	2	0	0	201-300	49
6	Eindhoven U of Technology	NL	2	287	2	143,50	1	0	0	301-400	104
7	Monash U	AU	5	273	3	54,60	1	1	0	78	60
8	U of Melbourne	AU	2	266	2	133,00	1	1	0	39	41
9	Boise State U	US	2	265	2	132,50	1	0	1	-	-
10	Kansas State U	US	4	228	3	57,00	1	1	0	501-600	751-800
11	Hong Kong Polytechnic U	CN	4	216	3	54,00	1	0	1	201-300	95
12	Accenture	US	2	213	2	106,50	1	1	0	-	-
13	U Pablo Olavide	ES	8	196	6	24,50	0	1	3	-	-
14	U of Colorado Denver	US	3	189	2	63,00	1	1	0	301-400	394
15	U of South Florida	US	2	187	2	93,50	1	1	0	201-300	501-550
16	U of Sheffield	UK	4	175	4	43,75	1	0	2	101-150	82
17	U of Hull	UK	2	171	2	85,50	1	0	0	-	601-650
18	U of Leeds	UK	2	154	2	77,00	0	2	0	101-150	101
19	U of Colorado Health Science Center	US	2	121	2	60,50	1	0	0	-	-
20	U of South Australia	AU	5	110	5	22,00	0	1	0	501-600	279
21	Oklahoma State U Stillwater	US	4	109	3	27,25	0	1	1	401-500	801-1000
22	U of Southern Queensland	AU	3	107	3	35,67	0	1	1	-	751-800
23	National Taiwan U of Science and Technology	TW	3	97	2	32,33	0	1	0	701-800	264
24	Ryerson U	CA	6	92	4	15,33	0	0	3	-	-
25	National Central U	TW	6	83	3	13,83	0	0	2	501-600	391
26	Old Dominion U	US	2	80	2	40,00	0	2	0	501-600	-
27	Beijing Normal U	CN	2	70	2	35,00	0	1	0	201-300	256
28	Hong Kong Baptist U	CN	2	70	2	35,00	0	1	0	601-700	299
29	University of Adelaide	AU	3	70	2	23,33	0	1	0	101-150	109
30	National Chung Cheng U	TW	5	68	4	13,60	0	0	2	-	-
31	U of Maryland College Park	US	4	56	3	14,00	0	0	1	53	129
32	National Taiwan U	TW	3	53	2	17,67	0	0	1	151-200	76
33	Islamic Azad U	IR	3	46	2	15,33	0	0	1	-	-
34	Shahid Beheshti U	IR	3	46	2	15,33	0	0	1	701-800	801-1000
35	Allameh Tabatabai U	IR	2	46	2	23,00	0	0	1	-	-
36	U of North Carolina	US	2	45	2	22,50	0	0	1	201-300	263
37	U of Ljubljana	SI	7	42	3	6,00	0	0	0	401-500	651-700
38	Concordia U	CA	2	42	2	21,00	0	0	1	401-500	431-440
39	Institut National Des Sciences Appliquees de Lyon INSA	FR	2	41	2	20,50	0	0	1	-	451-460
40	U of Teheran	IR	2	41	2	20,50	0	0	1	-	-
41	U of Warwick	UK	2	41	2	20,50	0	0	1	101-150	57
42	Istanbul Teknik U	TR	3	39	2	13,00	0	0	1	-	601-650
43	Marmara U	TK	2	39	2	19,50	0	0	1	-	-
44	Lappeenranta U of Technology	FI	3	38	1	12,67	0	0	1	-	501-550
45	U of Southampton	UK	3	37	2	12,33	0	0	1	101-150	102
46	U of Technology Sydney	AU	2	35	1	17,50	0	0	1	301-400	176
47	Aarhus U	DK	2	33	2	16,50	0	0	1	65	119
48	National U of Singapore	SG	3	32	3	10,67	0	0	0	91	15
49	Bar Ilan U	IL	2	32	2	16,00	0	0	0	-	551-600
50	Brunel U	UK	4	29	3	7,25	0	0	0	401-500	346

Abbreviations: Available in Table 1 and 2 except for: H = h-index; TC/TS = Citations per study; ARWU and QS = Ranking in the general ARWU and QS university rankings.

Table 4. Most productive and influential authors

R	Name	Institution	Country	TS	TC	TC/TS	H	≥ 100	≥ 50	≥ 20
1	Liang, HG	Florida Atlantic U	United States	2	930	465,00	2	2	0	0
2	Xue, YJ	Florida Atlantic U	United States	2	930	465,00	2	2	0	0
3	Hu, Q	Iowa State U	United States	3	922	307,33	3	1	1	1
4	Somers, TM	Wayne State U	United States	3	410	136,67	3	2	1	0
5	Nah, FFH	Missouri U of Science & Technology	United States	4	285	71,25	3	2	0	1
6	Gattiker, TF	Boise State U	United States	2	265	132,50	2	1	0	1
7	Law, CCH	Hong Kong Polytechnic U	China	2	214	107,00	2	1	0	1
8	Salmeron, JL	U Pablo de Olavide	Spain	7	196	28,00	6	0	1	3
9	Gunasekaran, A	U of Massachusetts Dartmouth	United States	2	194	97,00	2	1	0	1
10	Bhattacharjee, A	U of South Florida	United States	2	187	93,50	2	1	1	0
11	Karimi, J	U of Colorado Denver	United States	2	187	93,50	2	1	1	0
12	Abthorpe, MS	Nottingham Trent U	United Kingdom	1	169	169,00	1	1	0	0
13	Burgess, TF	U of Leeds	United Kingdom	2	154	77,00	2	0	2	0
14	King, SF	U of Leeds	United Kingdom	2	154	77,00	2	0	2	0
15	Koh, SCL	U of Sheffield	United Kingdom	2	138	69,00	2	1	0	1
16	Bueno, S	U Pablo de Olavide	Spain	3	99	33,00	2	0	1	1
17	Lopez, C	U Pablo de Olavide	Spain	4	92	23,00	4	0	0	2
18	Li, L	Old Dominion U	United States	2	80	40,00	2	0	0	2
19	Markowski, C	Old Dominion U	United States	2	80	40,00	2	0	0	2
20	Xu, L	Old Dominion U	United States	2	80	40,00	2	0	0	2
21	Sheu, C	Kansas State U	United States	2	79	39,50	2	0	1	0
22	Yen, HR	Kansas State U	United States	2	79	39,50	2	0	1	0
23	Ram, J	U South Australia	Australia	5	75	15,00	3	0	1	0
24	Wu, ML	United International College	China	3	75	25,00	3	0	1	0
25	Wang, ETG	National Central U	Taiwan	3	70	23,33	2	0	0	2
26	Dezdar, S	Universiti Malaya	Malaysia	2	61	30,50	1	0	1	0
27	Plaza, M	Ryreson U	Canada	4	59	14,75	3	0	0	2
28	Corkindale, D	U South Australia	Australia	4	56	14,00	2	0	1	0
29	Rohlf, K	Ryreson U	Canada	2	47	23,50	2	0	0	2
30	Ravasan, AZ	Allameh Tabataba'i U	Iran	2	46	23,00	2	0	0	1
31	Wu, LC	National Chung Hsing U	Taiwan	2	45	22,50	2	0	0	1
32	Botta-Genoulaz, V	Institut National des Sciences Appliquees de Lyon (INSA)	France	2	41	20,50	2	0	0	1
33	Denle, D	Oklahoma State U	United States	3	40	13,33	2	0	0	1
34	Kilic, HS	Mamara U	Turkey	2	39	19,50	2	0	0	1
35	Skibniewski, MJ	U of Maryland College Park	United States	3	37	12,33	3	0	0	1
36	Zaim, S	Istanbul Teknik U	Turkey	3	37	12,33	2	0	0	1
37	Ojiako, U	U of Southampton	United Kingdom	2	34	17,00	2	0	0	1
38	Ngwenyama, O	Ryreson U	Canada	2	33	16,50	2	0	0	1
39	Ghosh, S	U of Maryland College Park	United States	2	32	16,00	2	0	0	0
40	Shaul, L	Bar Ilan U	Israel	2	32	16,00	2	0	0	0
41	Tauber, D	Bar Ilan U	Israel	2	32	16,00	2	0	0	0
42	Ku, CY	National Chiao Tung U	Taiwan	3	29	9,67	2	0	0	1
43	Lin, WT	National Taiwan U	Taiwan	2	29	14,50	2	0	0	0
44	Yeh, TM	Diwan U	Taiwan	2	29	14,50	2	0	0	0
45	Jiang, JJ	U of Central Florida	United States	2	26	13,00	1	0	0	1
46	Klein, G	U of Colorado at Colorado Springs	United States	2	26	13,00	1	0	0	1
47	Adam, F	U College Cork	Ireland	1	25	25,00	1	0	0	1
48	Soja, P	Cracow U of Economics	Poland	3	24	8,00	3	0	0	0
49	Kamal, MM	Brunel U	United Kingdom	2	24	12,00	2	0	0	0
50	Chang, SI	National Chung Cheng U	Taiwan	2	21	10,50	1	0	0	1

Abbreviations available in Table 1, 3 and 3.

Table 5. Most productive and influential countries

R	Country	TS	TC	H	C/S	Pop	TS/Pop	TC/Pop	≥ 100	≥ 50	≥ 20
1	USA	77	4083	29	53,03	323127,51	0,24	12,64	11	9	19
2	United Kingdom	34	1613	16	47,44	65637,24	0,52	24,57	5	2	8
3	Canada	18	1106	9	61,44	36286,43	0,50	30,48	1	1	6
4	China	20	736	10	36,80	1378665	0,01	0,53	3	2	3
5	South Korea	8	591	6	73,88	51245,71	0,16	11,53	1	1	1
6	Taiwan	31	568	13	18,32	23113,99	1,34	24,57	0	3	6
7	Australia	23	561	10	24,39	24127,16	0,95	23,25	1	3	3
8	Saudi Arabia	7	367	4	52,43	32275,69	0,22	11,37	1	0	0
9	Netherlands	5	303	4	60,60	17018,41	0,29	17,80	1	0	0
10	Spain	15	210	6	14,00	46443,96	0,32	4,52	0	1	3
11	Italy	8	186	5	23,25	60600,59	0,13	3,07	1	0	0
12	Germany	12	105	5	8,75	82667,68	0,15	1,27	0	0	1
13	Singapore	5	105	4	21,00	5607,28	0,89	18,73	0	1	0
14	Iran	11	93	3	8,45	80277,42	0,14	1,16	0	0	2
15	Malaysia	5	91	3	18,20	31187,26	0,16	2,92	0	1	1
16	Switzerland	4	86	2	21,50	8372,1	0,48	10,27	0	1	0
17	France	7	85	4	12,14	66896,11	0,10	1,27	0	0	2
18	New Zealand	5	59	2	11,80	4692,7	1,07	12,57	0	0	1
19	Turkey	11	56	4	5,09	79512,43	0,14	0,70	0	0	1
20	Norway	3	48	2	16,00	5232,93	0,57	9,17	0	0	1
21	Poland	5	45	3	9,00	37948,02	0,13	1,19	0	0	0
22	Slovenia	8	42	3	5,25	2064,84	3,87	20,34	0	0	0
23	Finland	3	38	1	12,67	5495,1	0,55	6,92	0	0	1
24	Denmark	4	37	3	9,25	5731,12	0,70	6,46	0	0	1
25	Israel	3	33	2	11,00	8547,1	0,35	3,86	0	0	0
26	India	12	32	3	2,67	1324171,35	0,01	0,02	0	0	0
27	Bangladesh	1	27	1	27,00	162951,56	0,01	0,17	0	0	1
28	Ireland	1	25	1	25,00	4773,1	0,21	5,24	0	0	1
29	Greece	7	22	3	3,14	10746,74	0,65	2,05	0	0	0
30	Sweden	2	16	1	8,00	9903,12	0,20	1,62	0	0	0
31	Austria	2	12	2	6,00	8747,36	0,23	1,37	0	0	0
32	Sri Lanka	1	11	1	11,00	21203	0,05	0,52	0	0	0
33	Portugal	4	9	2	2,25	10324,61	0,39	0,87	0	0	0
34	Serbia	3	7	1	2,33	7057,41	0,43	0,99	0	0	0
35	South Africa	4	5	1	1,25	55908,86	0,07	0,09	0	0	0
36	Indonesia	2	5	1	2,50	261115,46	0,01	0,02	0	0	0
37	Slovakia	1	5	1	5,00	5428,7	0,18	0,92	0	0	0
38	Pakistan	4	3	1	0,75	193203,48	0,02	0,02	0	0	0
39	Qatar	2	3	1	1,50	2569,8	0,78	1,17	0	0	0
40	Croatia	3	3	1	1,00	4170,6	0,72	0,72	0	0	0
41	Kuwait	1	2	1	2,00	4052,58	0,25	0,49	0	0	0
42	Bosnia and Herzegovina	1	1	1	1,00	3516,82	0,28	0,28	1	1	1
43	Brazil	2	0	0	0,00	207652,86	0,01	0,00	0	0	0
44	Colombia	1	0	0	0,00	48653,42	0,02	0,00	0	0	0
45	Namibia	1	0	0	0,00	2479,71	0,40	0,00	0	0	0
46	Palestine	1	0	0	0,00	4816,5	0,21	0,00	0	0	0
47	Thailand	1	0	0	0,00	68863,51	0,01	0,00	0	0	0
48	United Arab Emirates	1	0	0	0,00	9269,61	0,11	0,00	0	0	0

Abbreviations available in Table 1, 2 and 3 except for: Pop = Population; TS/Pop = Studies per population; TC/Pop = Citations per Population.

Table 6. Most influential Journals

R	Name	TS	TC	H	TC/TS	≥ 100	≥ 50	≥ 20
1	MIS Quarterly	3	1143	3	381,00	2	1	0
2	Information Management	9	965	7	107,22	3	1	2
3	European Journal of Operational Research	3	866	3	288,67	2	0	1
4	International Journal of Production Economics	14	864	12	61,71	3	4	2
5	European Journal of Information Systems	9	473	8	52,56	1	1	3
6	Computers in Industry	12	422	7	35,17	2	0	1
7	Journal of Computer Information Systems	12	407	7	33,92	1	2	3
8	IEEE Software	1	351	1	351,00	0	0	0
9	Industrial Management Data Systems	8	277	6	34,63	0	3	1
10	International Journal of Production Research	8	271	7	33,88	1	0	4
11	Enterprise Information Systems	15	211	6	14,07	0	1	3
12	Journal of Management Information Systems	4	201	3	50,25	1	1	0
13	International Journal of Information Management	6	185	4	30,83	0	2	1
14	Journal of Information Technology	2	184	1	92,00	1	0	0
15	Information Systems Journal	6	179	6	29,83	0	0	4
16	Decision Support Systems	4	143	3	35,75	1	0	0
17	International Journal of Human Computer Interaction	2	141	1	70,50	1	0	0
18	International Journal of Operations Production Management	4	110	4	27,50	0	1	1
19	Information Systems Management	8	108	5	13,50	0	1	0
20	Industrial Marketing Management	1	84	1	84,00	0	1	0
21	Journal of Systems and Software	2	79	2	39,50	0	0	2
22	Supply Chain Management an International Journal	2	77	2	38,50	0	1	0
23	IEEE Transactions on Engineering Management	3	65	3	21,67	0	0	2
24	ACM Computing Surveys	2	59	2	29,50	0	0	1
25	Computer Standards Interfaces	3	52	2	17,33	0	0	1
26	Expert Systems with Applications	3	50	3	16,67	0	0	1
27	Production Planning Control	8	43	4	5,38	0	0	0
28	Total Quality Management Business Excellence	3	43	3	14,33	0	0	0
29	International Journal of Project Management	4	41	3	10,25	0	0	0
30	Journal of the Association for Information Systems	2	33	1	16,50	0	0	1
31	Journal of Database Management	2	27	1	13,50	0	0	1
32	Journal of Global Information Management	2	24	2	12,00	0	0	1
33	Behavior Information Technology	2	23	2	11,50	0	0	0
34	Information Systems Frontiers	3	17	2	5,67	0	0	0
35	International Journal of Technology Management	2	15	2	7,50	0	0	0
36	Business Process Management Journal	3	11	3	3,67	0	0	0
37	Journal of Enterprise Information Management	7	9	2	1,29	0	0	0
38	Journal of Global Information Technology Management	2	5	1	2,50	0	0	0
39	Ekonomska Istrazivanja Economic Research	2	4	1	2,00	0	0	0
40	Computers and electronics in Agriculture	1	4	1	4,00	0	0	0
41	Information Technology for Development	2	3	1	1,50	0	0	0
42	Telematics and Informatics	2	3	1	1,50	0	0	0
43	Project Management Journal	2	2	1	1,00	0	0	0
44	Strojnicki Vestnik Journal of Mechanical Engineering	2	2	1	1,00	0	0	0
45	International Journal of Advanced Computer Science and Applications	3	1	1	0,33	0	0	0
46	Communications of the Association for Information Systems	2	1	1	0,50	0	0	0
47	South African Journal of Industrial Engineering	2	1	1	0,50	0	0	0
48	International Journal of Enterprise Information Systems	3	0	0	0,00	0	0	0
49	Benchmarking an International Journal	2	0	0	0,00	0	0	0
50	Enterprise Information Systems Design Implementation and Management Organizational Applications	2	0	0	0,00	0	0	0

Abbreviations available in Table 1, 2 and 3