

# A Bibliometric Study of Informing Science: The International Journal of an Emerging Transdiscipline

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## Abstract

Informing Science is a young transdisciplinary science. the essential characteristics of which were defined fifteen years ago.

The journal *Informing Science: the International Journal of an Emerging Transdiscipline* (InformSciJ) is the flagship journal of transdisciplinary Informing Science. A study about the publication's influence and readership could be pertinent to better understanding the present state of Informing Science. To this end, we have performed a bibliometric study of first generation citations from InformSciJ. Publication data from Scopus were used. A bibliometric analysis based on citations to its papers may give clear indicators about the influence of this journal among institutions, countries, and researchers. This study also provides an overview of knowledge dissemination in various disciplines. Moreover, a citations study may be a barometer of the evolution of a transdiscipline.

The study demonstrates the high degree of transdisciplinarity of Informing Science. It is also confirmed that after more than a decade the Informing Science Institute continues to bring together researchers working in IS from many disciplines and nations.

The study confirms that it is possible to observe the evolution of a new transdiscipline by analysing the citations to papers from its flagship journal.

**Keywords:** Bibliometric analysis, transdisciplinarity, citation analysis, Informing Science.

## Introduction

The fields of Informing Science (IS) were defined in 1999, by Eli Cohen in his seminal article as "The fields that comprise the discipline of Informing Science provide their clientele with information in a form, format, and schedule that maximizes its effectiveness" (Cohen, 1999).

In a decade this discipline has contributed greatly to bring together researchers working in IS

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from many disciplines, including Management Information System (MIS), education, library science, and computer science (Gill & Bhattacharjee, 2007).

The publishing activity of the Informing Science Institute (ISI) has been increasing enormously since the first issue of *Informing Science: the International Journal of an Emerging Transdiscipline* (InformSciJ) in 1997. ISI has under-

taken the publication of seven additional journals and more of twenty books. Two annual international conferences are also managed by ISI (Gill & Cohen, 2009).

InformSciJ has the mission to be the principal channel for sharing knowledge in the fields that comprise the discipline of Informing Science (Gill, 2009).

The term transdiscipline in InformSciJ's title is a relatively new term according to Choi and Pak's (2006). The authors found the first definitions of "transdiscipline" in on line literature published in 1979 (Gossman, 1979) and in peer-reviewed publications published in 1992 (Rosenfield, 1992). The Charter of Transdisciplinarity was adopted at First World Congress of Transdisciplinarity, Convento da Arrábida, Portugal, November 2-6, 1994. ("Charter of transdisciplinarity," 1994)

What is a transdiscipline? Terms like multidisciplinary, interdisciplinarity, and transdisciplinarity describe activities that involve multiple disciplines. Let's get a closer look to some definitions by first taking some examples from health and social sciences:

- Multidisciplinary : Working with several disciplines
- Interdisciplinary : Working between several disciplines
- Transdisciplinary: Working across and beyond several disciplines. Members from different disciplines working together using a shared conceptual framework (Rosenfield, 1992). This usage of the term was introduced by Jean Piaget in 1970. (Nicolescu, 2002)

In others words, transdisciplinarity is a specific form of interdisciplinarity in which boundaries between and beyond disciplines are transcended and knowledge and perspectives from different scientific disciplines, as well as non-scientific sources, are integrated (Flinterman, Teclemariam-Mesbah, Broerse, & Bunders, 2001)

The authors that have published in ISI publications come from a wide and varied multidisciplinary community. Having such publications allows information to reach a large number of consumers such as academic researchers (Cohen, 2009; Murphy, 2011). Those consumers, academic researchers, use ISI journals articles and cite them in different disciplines. The aim of this study is to observe the evolution of the Informing Science transdiscipline by analyzing the citations to papers from its flagship journal.

Our study is based on bibliometric citation analysis. The term bibliometric refers to a branch of library and information science that provides quantitative characterization of scientific activity. The technique used in this paper is known as citation analysis that is based on the postulate that scientist cite documents they consider to be important to their research (Garfield, 1955, 1997). A "citation" is quantifiable item in bibliometrics. This unit of analysis is the referencing of a document by a more recently published document. The document making the citation is the "citing" document, and the one receiving the citation is the "cited" document. (Börner, Chen, & Boyack, 2003).

The methodological approach to characterize interdisciplinary research using citation analysis has been a research method for the last decades (Chubin, Porter, & Rossini, 1984). Others methods based on web search data are being developed (Sayama & Akaishi, 2012) but data gathering needs a great deal of cleaning work. The data is less structured and noisier than data collected from commercial citation indexing services such as Thomson Reuters's Web of Science (WoS) or Elsevier's Scopus. (Glänzel, 2012).

Google Scholar is another source that is used for citation analysis. Google Scholar, a service provided by Google, enables searches for scholarly publications. However, it does not meet all requirements of bibliometric study: proper documentation about coverage is missing (Yang &

Meho, 2006), a lot of changes of sources and citations happen within in short time periods. Therefore, reproducibility of search results is limited (Glänzel, 2012; Jasco, 2009). One of the major disadvantages of using this resource, due to the way the items are retrieved, is that there is often a large, and sometimes ambiguous, set returned. This can lead to very tedious data cleaning in order to gather the relevant data so as not to present obscure results (Meho & Yang, 2007). For this reason Google Scholar was not considered for this study.

“Publish or Perish” (PoP) is a downloadable software developed by Prof. Anne-Wil Harzing of Melbourne University (Harzing, 2007). PoP provides an evaluation method for journals. This can be executed by pulling into a set all the articles published in them over a period of time and then calculating the h-index for the journal title (Gazni, Sugimoto, & Didegah, 2012). This tool was discarded for the present study for two reasons: first, it is not possible to pull in a set the “citing articles”; second, this service uses Google Scholar to obtain citations.

A new tool “CleanPoP” is being developed. In the future, to calculate metrics one interesting way will be to search Google Scholar with PoP and then to clean results using CleanPoP (Baneyx, 2008).

Already, an analysis of authors, institutions, and countries of origin from Informing Science Institute (ISI) papers published between 1998 and 2009 was done in 2011 (Murphy, 2011). In his work, the study objects were all ISI papers published between 1998 and 2009. Murphy showed that 65 % of ISI journal articles were written by authors affiliated with universities outside United States. He also analyzed the question of multidisciplinary and concluded that ISI achieves relevance by publishing articles that examine questions related to informing.

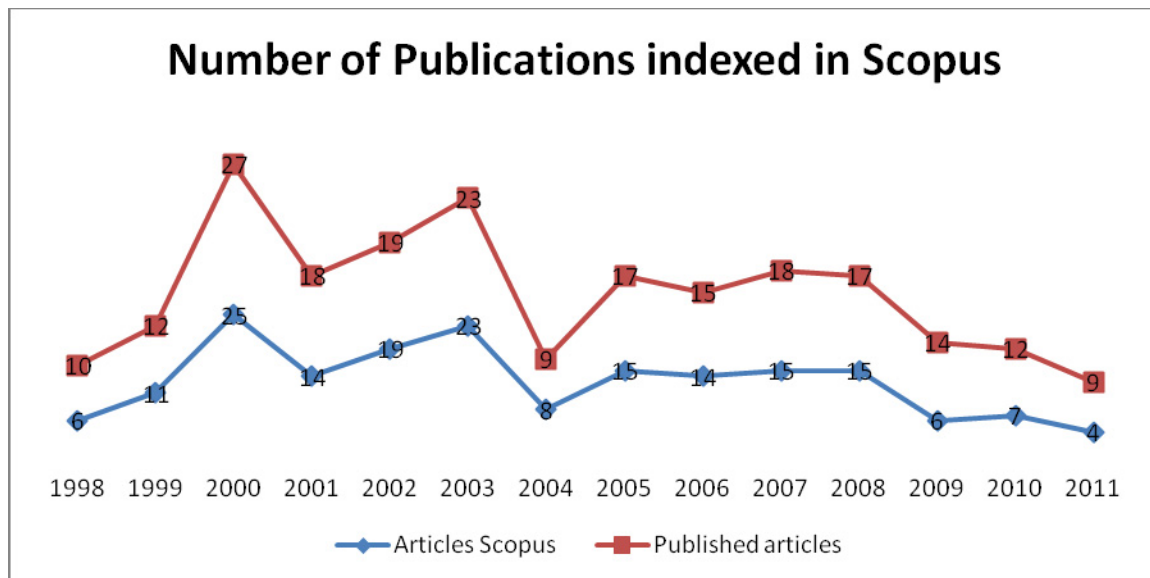
In this paper the study object is the scholarly citations to InformSciJ. A bibliometric analysis based on citations to its papers could be fruitful as it can give clear indicators about the influence of the journal among institutions, countries, researchers, and subject areas. We focus the flagship journal of transdisciplinary Informing Science readership as sample to explore IS evolution.

## **Data Gathering and Methodology Stages**

InformSciJ is indexed in several directories and data sets such as the Cabell's Directory of Publishing Opportunities in Educational Technology & Library Science, Information Science Abstracts, Ulrich Web Global Serials Directory, and Scopus from Elsevier. Scopus allows users to conduct a citation analysis. To achieve the objective of this study, the data set was extracted from Elsevier's Scopus.

Scopus is a multidisciplinary bibliographic database of peer-reviewed research literature. It has been provided by Elsevier since 2004. Scopus is designed for bibliometric use. It covers more than 19,500 titles (including 1,800 Open Access journals) from more than 5,000 international publishers in the scientific, technical, medical, social sciences fields and arts and humanities (Osareh, 1996).

Scopus has a good coverage, but information is not indexed cover to cover. In fact, not all articles from InformSciJ are indexed. For example during 2012 only 3 articles out of 12 could be extracted.



**Figure 1: Number of indexed publications compared to number of InformSciJ published articles**

184 InformSciJ articles are indexed in Scopus between 1997 and 2012 (extracted data on October 2012). If we compare that with the number of published articles of 229, the rate of indexed papers is 0,80. This rate must be taken into account when considering the results of the current analysis. In fact, it is important to bear in mind that for any bibliometric analysis, indicators are given for a specific period and for a specific set of publications extracted from a data base that as a rule indexes selectively within the journal and from selected journals, not from the universe of all possible journals.

In this work, the “citing” documents to InformSciJ’s papers (cited) are studied. For each InformSciJ paper we retrieved the set of “citing” documents, also referred to as “first generation citations”. The total number of retrieved citing publications (or first generation citations) was 857. Thus, the set was cited 963 times. This is to say that in Scopus database there are 857 articles from different sources that cite in their bibliography one or more articles from InformSciJ.

The study stages of these 857 references are shown in Figure 2. The data set was processed with Sphinx® and VantagePoint®, two lexical analyzer software programs. First, a citation analysis to compute the frequency of citations to InformSciJ articles was done in order to calculate the impact force. Second, we identified the relationship between different countries by using VantagePoint. This program allowed us to build-up countries co-occurrence. The Aduna® script cluster map will show the visualization of the most frequent collaborations.

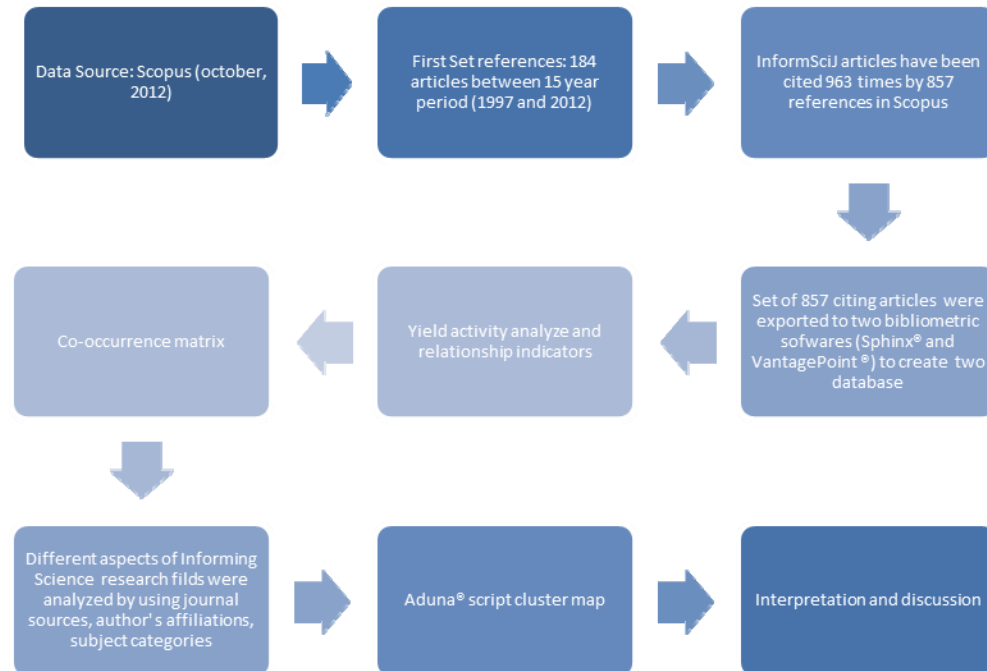


Figure 2: Study stages

## Results

In this section, we put forward the results of the bibliometric analysis. We start with InformSciJ articles impact measures: h-index and articles citation impact ranking. In a second time we treat citing (or first generation citations) publications. The total number of citing papers in this part of the study is thus 857. Let FGC denote this set.

### *Impact Measures*

#### **InformSciJ articles impact measures**

Citation impact measures the recognition of published results through citations. The impact of each individual article can be compared by sorting them by cited article rank. In Scopus this is easily done by chosen “sort cited by”. The paper with the greatest impact is at top of InformSciJ articles list.

The h-index quantifies the journal’s number of articles that have received at least h citations. It is an indicator of both journal scientific productivity and scientific impact. In our case, if we consider the impact of 184 articles, 12 of them have been cited at least 12 times. As we see in Figure 3, the h index is 12.

## A Bibliometric Study of Informing Science

Document title	Author(s)	Date	Source title	Cited by
Human information behavior	Wilson, T.D.	2000	Informing Science 3 (2), pp. 49-55	209
Image information retrieval: An overview of current research	Goodrum, A.A.	2000	Informing Science 3 (2), pp. 63-67	59
Developing a framework for assessing information quality on the World Wide Web	Knight, S.-A., Burn, J.	2005	Informing Science 8, pp. 159-172	54
A systems approach to conduct an effective literature review in support of information systems research	Levy, Y., Ellis, T.J.	2006	Informing Science 9, pp. 181-211	26
Social informatics in the information sciences: Current activities and emerging directions	Sawyer, S., Rosenbaum, H.	2000	Informing Science 3 (2), pp. 88-95	23
Computer self-efficacy: A practical indicator of student computer competency in introductory IS courses	Karsten, R., Roth, R.M.	1998	Informing Science 1 (3), pp. 61-68	23
Interactive information retrieval: Context and basic notions	Robins, D.	2000	Informing Science 3 (2), pp. 57-61	19
Task complexity and informing science: A synthesis	Gill, T.G., Hicks, R.C.	2006	Informing Science 9, pp. 1-30	15
A cognitive approach to instructional design for multimedia learning	Sorden, S.D.	2005	Informing Science 8, pp. 263-279	13
Navigation assistance in virtual worlds	Van Dijk, B., Op Den Akker, R., Nijholt, A., Zwiers, J.	2003	Informing Science 6, pp. 115-125	13
The value of user participation in E-commerce systems development	Terry, J., Standing, C.	2004	Informing Science 7, pp. 31-45	12
Relevance: An interdisciplinary and information science perspective	Greisdorf, H.	2000	Informing Science 3 (2), pp. 67-71	12
Open source: A metaphor for E-learning	Koohang, A., Harman, K.	2005	Informing Science 8, pp. 75-86	11

**Figure 3: Screenshot of Scopus interface shows the data for the set of thirteen publications ranked by the number of times each publication has been cited**

**Table 1: The data for the set of top ten publications ranked by time cited**

Authors	Title	Year	Volume	Cited by
Wilson, T.D.	Human information behavior	2000	3	209
Goodrum, A.A.	Image information retrieval: An overview of current research	2000	3	59
Knight, S.-A., Burn, J.	Developing a framework for assessing information quality on the World Wide Web	2005	8	54
Levy, Y., Ellis, T.J.	A systems approach to conduct an effective literature review in support of information systems research	2006	9	26
Sawyer, S., Rosenbaum, H.	Social informatics in the information sciences: Current activities and emerging directions	2000	3	23
Karsten, R., Roth, R.M.	Computer self-efficacy: A practical indicator of student computer competency in introductory IS courses	1998	1	23
Robins, D.	Interactive information retrieval: Context and basic notions	2000	3	19
Gill, T.G., Hicks, R.C.	Task complexity and informing science: A synthesis	2006	9	15
Sorden, S.D.	A cognitive approach to instructional design for multimedia learning	2005	8	13
Van Dijk, B., Op Den Akker, R., Nijholt, A., Zwiers, J.	Navigation assistance in virtual worlds	2003	6	13

Table 1 lists the ten articles that are the most cited. This list was compiled from all of the journal's publications during the period 1997 – 2012, therefore it needs to be remembered that the older publications are more likely to have more citations than more recent publications.

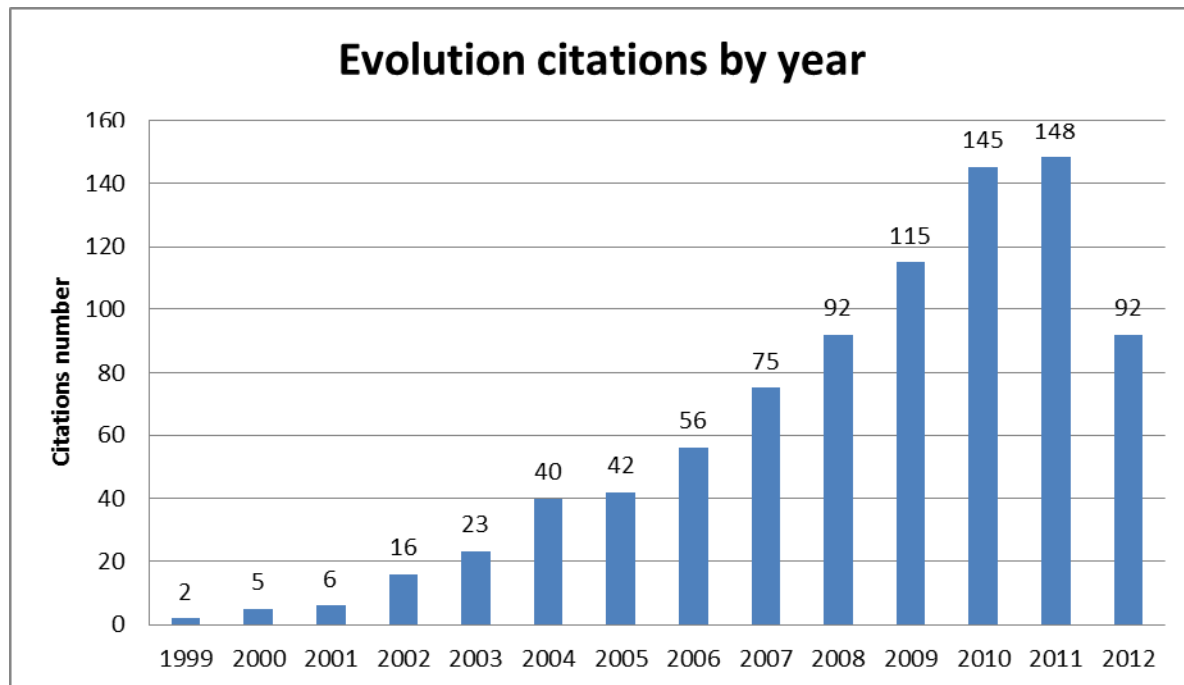
### Citing articles or first generation citations to InformSciJ

This part of our study will consider the FGC set of 857 citations to 184 InformSciJ articles published from its foundation in 1997 through 2012. For this set, 29 articles have been cited at least 29 times (the h index is 29). The higher number of citations indicates a sustained level of relevance in our field of research. The ten most influential works are shown in Table 2.

**Table 2: Top ten cited articles of FGC to InformSciJ articles**

Authors	Title	Year	Source title	Cited by
Markus, M.L.	Toward a theory of knowledge reuse: Types of knowledge reuse situations and factors in reuse success	2001	Journal of Management Information Systems	289
Blei, D.M., Jordan, M.I.	Modeling Annotated Data	2003	SIGIR Forum (ACM Special Interest Group on Information Retrieval)	209
Kherfi, M.L., Ziou, D., Bernardi, A.	Image retrieval from the World Wide Web: Issues, techniques, and systems	2004	ACM Computing Surveys	126
Kling, R.	Learning about information technologies and social change: The contribution of social informatics	2000	Information Society	115
Moody, D.L.	Theoretical and practical issues in evaluating the quality of conceptual models: Current state and future directions	2005	Data and Knowledge Engineering	103
Pettigrew, K.E., Fidel, R., Bruce, H.	Conceptual frameworks in information behavior	2000	Annual Review of Information Science and Technology	78
Bilal, D., Kirby, J.	Differences and similarities in information seeking: Children and adults as Web users	2002	Information Processing and Management	77
Fisher, K.E., Durrance, J.C., Hinton, M.B.	Information grounds and the use of need-based services by immigrants in queens, New York: A context-based, outcome evaluation approach	2004	Journal of the American Society for Information Science and Technology	63
Heinström, J.	Five personality dimensions and their influence on information behaviour	2003	Information Research	58
Widén-Wulff, G., Ginman, M.	Explaining knowledge sharing in organizations through the dimensions of social capital	2004	Journal of Information Science	56

Another metric indicator is the evolution of citations during the studied period. Figure 4, illustrates the impact trend for the dataset. This evolution of citations is in part the consequence of the window of time during which those articles have been available; the longer an article is available and the more are the chances to be cited. Nevertheless, Table 2 shows that the list of top ten articles ranked by citation counts does not follow an ascending chronological order.



**Figure 4: Distribution of citations between 1999 and 2012**

From Figure 4 the citation evolution is exponential giving a mean value of about 70 citations during the last ten years.

### Document type, language, scholar source

Other quantifiable indicators can be extracted from the FGC data set. These items are the documents type, the language of references, and the source (journals, proceedings, books, etc).

Concerning the document type of citations they are mainly articles, and conference papers as shown in Table 3.

**Table 3: Distribution by document type**

Document type	Nb	% cit.
Article	535	62,40%
Conference Paper	256	29,90%
Editorial	2	0,20%
Letter	1	0,10%
Note	1	0,10%
Review	62	7,20%
Total	857	1

The documents' language is 95% English, and the other 5% is composed of 12 different languages: Portuguese, Persian, Spanish, German, Chinese, Croatian, Czech, Estonian, French, Japanese, Lithuanian, and Turkish. This is an indicator of the wide dissemination of InformSciJ publications in different countries, if English is seen as the international research language. Countries have journals for domestic users written in their own languages.



The examination of FGC sources includes a criterion to find users' discipline origin. Articles were published in 160 different sources. According to the number of citations by source title it is possible to have an idea of the best ranked in terms of references number. Table 4 shows the top fifteen sources where articles from InformSciJ have been cited. Two titles published by the Informing Science Institute are also indicated.

**Table 4: Top Ten FGC sources**

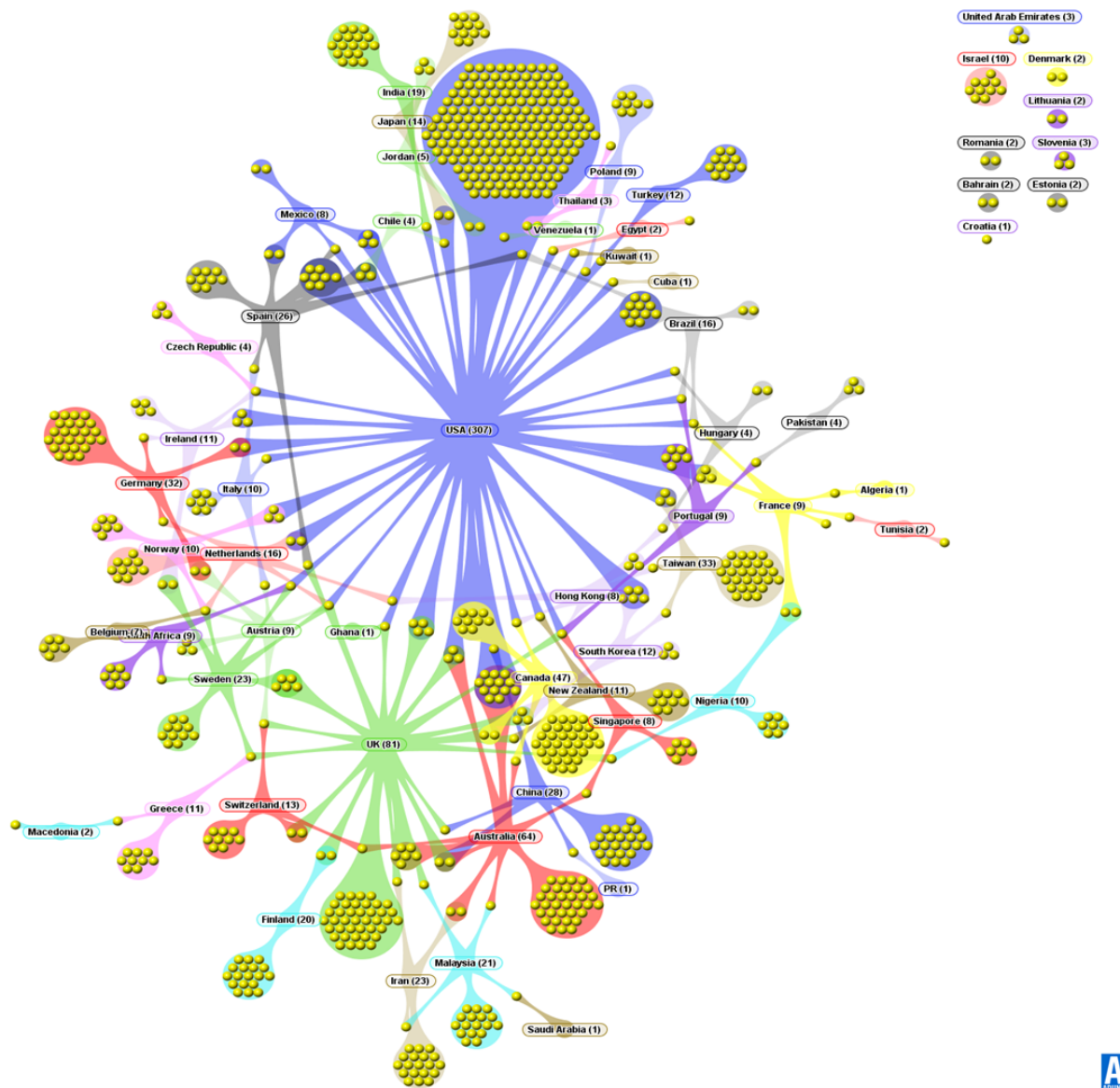
Source title	# citations
Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics	49
Informing Science	48
Information Research	41
Journal of the American Society for Information Science and Technology	36
Information Processing and Management	14
Proceedings of the ASIST Annual Meeting	12
Proceedings of the Annual Hawaii International Conference on System Sciences	11
ACM International Conference Proceeding Series	10
Communications in Computer and Information Science	10
Interdisciplinary Journal of Information Knowledge and Management	9
Annual Review of Information Science and Technology	9
Computers in Human Behavior	9
Journal of Documentation	9
Library and Information Science Research	9
Ciencia Da Informacao	7

We observe from Table 4 that 28% of citations to InformSciJ are from papers published in this journal and from the *Interdisciplinary Journal of Information Knowledge and Management*, another IS Institute journal. Nevertheless the 72% of top ten articles come from other well-known journals and conferences proceedings.

### ***Exploring Data Extracted from Authors' Affiliation***

#### **Mapping the papers production according to countries**

VantagePoint allowed us to build-up a countries co-occurrence matrix. The matrix was used to visualize the international dimension of citations to InformSciJ publications.



**Figure 5: Paper production by countries**

In Figure 5 each country has a different color and each dot represents one citation. The map shows the central position of United States and United Kingdoms.

There are 59 different countries in authors' affiliation addresses. The top 25 countries where authors cite the journal are USA, UK, Australia, Canada, Taiwan, Germany, China, Spain, Iran, Sweden, Malaysia, Finland, India, Brazil, Netherlands, Japan, Switzerland, South Korea, Turkey, Greece, Ireland, New Zealand, Israel, Italy, Nigeria, Norway, Austria, France, Poland, and Portugal.

## Subject Areas

This analysis is made on the basis of Scopus subject categories.

Articles published in this journal are placed in only one subject area according to Scopus: Social Science. Nevertheless, FGC to this journal are published in multiple sources in different fields. Among them are Computer Science, Social Sciences, Engineering, Mathematics, Business, Man-

agement and Accounting, Decision Sciences, Psychology, Biochemistry, Genetics and Molecular Biology, Medicine, and Arts and Humanities.

Though papers from Computer Science and Social Science are numerous 66%, the other 44% comes from a broad-spectrum (20 subjects).

In fact, the FGC are spread in 22 subject categories; one journal can be in more than one category (Table 4)

**Table 4: Subject categories**

Subject categories	# Citations
Computer Science	483
Social Sciences	394
Engineering	109
Mathematics	75
Business, Management and Accounting	70
Decision Sciences	51
Psychology	32
Biochemistry, Genetics and Molecular Biology	31
Medicine	27
Arts and Humanities	16
Agricultural and Biological Sciences	9
Economics, Econometrics and Finance	7
Health Professions	7
Materials Science	7
Physics and Astronomy	7
Earth and Planetary Sciences	6
Environmental Science	4
Multidisciplinary	4
Nursing	3
Chemical Engineering	2
Neuroscience	2
Energy	1

## Discussion and Conclusions

In this bibliometric study, where publication data from Scopus were used, we have treated a set of first generation citations to InformSciJ. We recognized that there were limitations intrinsic to the data set. We analyzed the journal readership.

The findings presented in previous sections lead to the following conclusions:

- The impact trend of first generation citations has increased, as shown in Figure 4. The “h-index” of the FGC is 29.
- The subject categories are varied up to 22 (Table 4), which demonstrate the high degree of transdisciplinarity of Informing Science, even if there is a concentration in Computer Science, Social Sciences, and Engineering with more the 100 references for each other.

- Compiling the affiliation data reveals, as shown in Figure 5, the particular influence of United States and United Kingdom, but gives us one overview of the variety of countries where users come from.

We recognize, as does Murphy (2011), that authors and readers may use knowledge from variety of fields and that the journal is a “meeting ground between disciplines” (T. Grandon Gill, in Murphy, 2011). Nevertheless, there is a slight difference in international contribution trends: the second country in number of articles is United Kingdom and not Australia for our set.

This study confirms that after more than a decade the Informing Science philosophy continues to bring together researchers working in IS from many disciplines and nations. Moreover, IS as framework is encouraging the transdisciplinarity movement of science, research and practice.

### ***How is the Informing Science Transdiscipline Going to Move Forward?***

The survey by citation analysis is one of the ways helping to provide the answers to these questions. After InformSciJ others ISI journals have been added. It could also be useful to do a bibliometric study for those journals to have an overview of the transdiscipline’s evolution.

But even at the current level aggregation, bibliometric should always be used as a complementary tool to other analytical approaches. As pointed out earlier, the present study has its own limitations because the bibliometric analysis was done with data indexed by only one commercial data base. Researchers should use these methods as a complement to traditional qualitative methods of reviewing literature.

We must remember that “*Rigor*, *openness*, and *tolerance* are the fundamental characteristics of the transdisciplinary attitude and vision. *Rigor* in argument, taking into account all existing data, is the best defense against possible distortions. *Openness* involves an acceptance of the unknown, the unexpected and the unforeseeable. *Tolerance* implies acknowledging the right to ideas and truths opposed to our own ” (“Charter of transdisciplinarity,” 1994).

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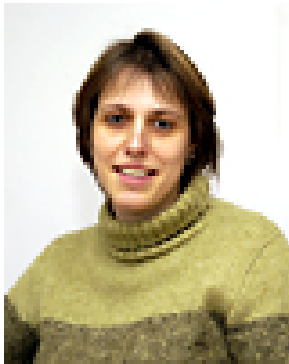
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## Biographies



**Amanda Regolini** has 25 years of experience as information specialist. She is a research engineer at Irstea, where she has been responsible for the bibliometric analysis since 2006.



**Emmanuelle Jannès-Ober** is geographer and has more than 25 years of experience in managing scientific and technical information. She has worked for different international organizations in Africa and 10 years for the Institut Pasteur in Paris. Since 8 years, she is the head of the Scientific and Technical Information Department of Irstea. Since 3 years, she is also Deputy Director of the Direction of Foresight and Scientific Watch of Irstea.