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10 Years of the International Journal of Information Science and Management: A Scientometric and Social Network Analysis Study

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Abstract

This paper aims to study the performance of the International Journal of Information Science and Management (IJISM) over a decade using a scientometric approach. It also aims to study the co-authorship network of authors and institutions using different macro- and micro-level Social Network Analysis metrics. A total of 173 articles published in 23 issues of the IJISM covering the period 2003-2012 were analyzed in this study. The findings revealed that multi-author articles (69.1%) published in the journal far outnumbered single-author articles. Two-author papers comprise the highest percentage (46.2%) of total papers compared with other authorship patterns. The results showed that the co-authorship network of authors in the IJISM is a small world network by demonstrating its short distance and scale free properties. Moreover, the famous notion of six degree of separation can be valid in this network. The study also identified central and critical authors and institutions in IJISM's collaboration network based on centrality, citation impact and productivity measures.

Keyword: International Journal of Information Science and Management (IJISM), Scientometric study, Social network analysis

Introduction

Scientometric studies on single journals assess scientific performance of journals based on bibliographic data. These studies can indicate the quality, maturity, and productivity of the journal in different fields. Findings of such studies reveal detailed facts of the publications and give a comprehensive picture and portrait of the journal. The findings have useful impact for determining ranking of prolific authors, core papers, potential publications, co-authorship of institutions and universities, author productive patterns, highly cited papers as well as productivity of a journal in a region or country. Moreover, these studies can facilitate

scientific policy-making and planning. Although the common assessment method used for single journal studies is scientometrics, the Social Network Analysis (SNA) approach can also be used to study collaboration networks in a single journal. Since its emergence in anthropology, psychology and sociology research in the 1930s, SNA has evolved into a popular technique to study the topological features of networks as well as to identify the function of actors. SNA views social relationships in terms of the network theory, consisting of nodes (representing individual actors within the network) and ties (representing relationships between the individuals). This method has been successfully used in the analysis of co-authorships networks in the past. Co-authorship networks are social networks constructed by connecting actors in case they have co-authored together.

The Regional Information Center for Science and Technology (RICeST) is an Iranian governmental organization in Shiraz established to promote the production and distribution of scientific information in Iran and Islamic countries (Mehrad, Nowrouzi Chakeli & Dayani, 2008). It was established by Professor Jafar Mehrad as the Regional Library of Science and Technology (RLST) in 1991 as a result of an agreement between the Ministry of Culture and Higher Education of Iran and the Third-World Academy of Sciences. *International Journal of Information Science and Management (IJISM)* is known as one of the publications of the RICeST. It is an international peer-reviewed academic journal in the areas of Scientometrics, Webometrics, Library and Information Science, Information Management, Informatics and Information Technology. It was first published in 2003 as the *Iranian Journal of Information Science and Technology (IJIST)*. Later in 2008, the journal was renamed into the *International Journal of Information Science and Management (IJISM)*.

In celebration of the *IJISM's* 10th anniversary, this article uses both scientometric and SNA approaches to study the performance of the journal as well as to analyze the collaboration network of authors and institutions who have contributed to the journal during the past decade (2003−2012). The study is structured around the following specific research objectives:

a) To study distribution of papers published in the *IJISM* by year;
b) To study authorship patterns of papers published in the *IJISM*;
c) To study collaboration patterns of papers published in the *IJISM*;
d) To study collaborative measures in papers published in the *IJISM*;
e) To study geographical origin of paper published in the *IJISM;*
f) To visualize and study the co-authorship network of authors in the *IJISM*; and
g) To visualize and study the co-authorship network of institutions in the *IJISM*.

Literature Review

An extensive literature has developed studying the function of journals in the area of Library and Information Science using scientometric indicators. A review of the literature was

conducted to investigate and summarize previous related studies. In one of the first studies, Meadow and Zaborowsk (1979) studied the authorship characteristics of the *Journal of the American Society for Information Science & Technology* (previously known as the *Journal of the American Society for Information Science* or *JASIS*). Results of the study revealed that most of the authors in *JASIST* (43 out of 54) were from the United States of America. The top ten most frequent journals cited by the *JASIST* papers were also mentioned in this study. In another study, Harter and Hooten (1992) explored nine volumes of the *JASIST* (1972-74, 1982-84, and 1988-90) using scientometric indicators. The results showed that 18 out of 391 articles were not cited at all, and 75% were cited nine or fewer times. Among all the 391 articles published in the *JASIST* during the examined years, 126 were funded; just under one-third and highly cited articles are as likely to be funded. Al-Ghamdi et al. (1998) undertook a scientometric study on the *JASIST*, to determine the publication trends and patterns of research in the area of LIS. They observed that the majority of articles are single authored (61%), indicating that the LIS field is not highly collaborative. Results of the study also showed an increasing publication trend of females, non-American authors and authors from LIS schools.

Lipetz (1999) studied 5-year issues (1955, 1965, 1975, 1985 and 1995) of the *JASIST* with the objective of comparing the authorship patterns of the journal in 5 decades. Findings revealed that the number of papers published per year in the *JASIST* had grown exponentially from 21 (1955) to 68 (1995). Authorship has also grown from 34 to 130 with a doubling time of about 20 years which is similar to the growth pattern of the *JASIST* papers. Additionally, academic affiliation increased from less than 25% in 1955 to 90% in 1995. Another study was carried out by Tiew, Abdullah and Kaur (2002) on the *Malaysian Journal of Library & Information Science* from 1996 to 2000. The results revealed that most of the articles (67.1%) published in the journal contained no acknowledgement. Authors affiliated to LIS schools were well represented (55.2% of the authors) in the journal. Moreover, 36 out of 80 authors who contributed in the studied articles were affiliated to Malaysian universities or research centers. The results of this study were compared with those from 2001 to 2006 in a follow-up research conducted by Bakri and Willet (2008). The analysis showed that there have been statistically significant changes in the types of articles, in the numbers of references per article and in the lengths of the articles compared with the findings of Tiew, Abdullah and Kaur (2002) study.

Bharvi, Garg, and Bali (2003) analyzed 1317 papers published in the first fifty volumes of the international journal *Scientometrics* during 1978 to 2001. They revealed that American contribution in terms of productivity seemed to be on the decline and those from the Netherlands, India, France and Japan was increasing. Single authored papers predominated but multi-authored works were increasing. Similar pattern has been observed for domestic and international collaboration. In another study, Garg (2003) analysed articles published in the

international journal of *Scientometrics* during 1978 and 2000. He provided a comprehensive review and listed all studies on cross national, national and institutional assessments using scientometric methods. The publications were categorized by types of study and under each type the works were listed under the author's country. In 2003, Liu studied *JASIST* to find out the author productivity and co-authorship patterns of 208 published papers during 2001-2002. There were 364 authors contributing to articles, out of which 321 (88.0%) wrote only one article. The observed ratio of authors with two or more articles was lower than expected according to Lotka's law of author productivity. Further, single-authored works predominated (42.3%), followed by two authors (28.8%) and three or more authors (28.8%).

In another study, Naqvi (2005) analyzed 251 articles published in the *Journal of Documentation* between 1994 and 2003. The results revealed that over 55.8% of articles were single-authored with two works about 27.9%. Additionally, the number of references used by the authors was high with 45% citing 21 to 50 references, and 33.4% citing 1 to 20 references. Young (2006) studied *Library Quarterly* during 1956 to 2004 bibliometrically. Contributor attributes, author rankings and citation impact were analyzed in this paper. Results revealed that more than 50% of the top 30 contributors had served on the editorial board of the *Library Quarterly* and a large majority of them were either from the University of Chicago (publisher of the journal). A correlation between the most highly cited authors within *Library Quarterly* corpus and these authors' citations on the Web of Science database were found. It was also found that *Library Quarterly* continues to receive contributions from nearly one-half of the world's most cited LIS researchers. In another study, 20 issues of the *Annals of Library and Information Studies (ALIS)* published between 2002 and 2006 were studied by Chaurasia (2008). The results showed that most of the papers were published by the Library Science professionals affiliated to university and college libraries and the majority of contributions were from India (96.2%). Additionally, majority of the LIS researchers have cited journal papers in large number (50.15%), while books come on second with 273 (19.96%) citations.

Studying LIS research in Pakistan, Naseer, and Mahmood (2009) investigated papers published in the *Pakistan Library and Information Science Journal* from 1998 to 2007. The results showed that mostly Asian authors, predominantly Pakistani authors, contribute to the journal. Moreover, male authors lead the LIS research scene but contributions from female authors have increased.

Rosy (2009) reported citation analysis of 593 articles published in the *Library Trends* journal during 14 years. The journal contained 15662 references for the study period of which 13783 were paper citations and 1879 were electronic citations. Authors consulted 44.04% of p-journals as compared with 11.82% of e-journals. Findings showed that female researcher's contribution accounts more than male's contributions. In one of the most relevant studies to the current paper, Mulla (2011) mapped 101 research articles published in the *International Journal of Information Science and Management (IJISM)* during 2003-2009. Results showed

that the average number of authors per volume was 27.14 and the greatest number of authors (49.47%) contributed to two-authored papers. Out of the total 190 contributions, Iran stands in the first rank with 157 contributions, followed by the UK, Germany, India, Nigeria, China, Bangladesh and Malaysia, respectively.

Other studies also used the SNA approach to investigate the function of journals in the area of LIS. In one of these studies, Hou, Kretschmer and Liu (2008) studied the structure of scientific collaboration network at micro level by using data of all paper published in the international journal of *Scientometrics* during 1978-2004. Chen, Fang, and Borner (2011) studied the development of the international journal of *Scientometrics* from 2002 to 2008 and mapped the distribution and collaboration network of countries as well as top institutions. They analyzed the co-author network to map the collaboration among different authors. They also mapped the co-citation network of papers to show the major topics that affected the development of this journal. In another study using co-authorship data from 3125 articles published in the journal of *Scientometrics*, Erfanmanesh, Rohani and Abrizah (2012) examined the collaboration network in the field of scientometrics. Results of the study revealed that the percentage of co-authored papers represents 54.78% of the total number of papers published in the international journal *Scientometrics.* Moreover, the scientometrician's collaboration network forms "small-world" topology in which two randomly selected authors are typically separated by a short path, and the network has demonstrated the presence of clustering.

Methodology

The present paper applies scientometrics and SNA approaches. The sample for the study included all the papers published in the *International Journal of Information Science and Management (IJISM)* from the first issue in 2003 until the end of the 2012. In the first ten years of the journal, 173 articles were published by 265 unique authors representing 81 institutions from 22 countries. Papers published in the journal during the examined years were retrieved from the journal's website. Data were analyzed by descriptive statistics using Microsoft Excel software. Three measures namely, Collaboration Index (CI), Degree of Collaboration (DC) and Collaboration Coefficient (CC) were applied to study collaborative measures in papers published in the journal. According to the discussion of collaborative measures by Liao and Yen (2012), the equations for the three aforementioned measures are as follows:

$$\mathrm{CI} = \frac{\sum_{j=1}^{q} jfj}{N}$$

$$\mathrm{DC} = 1 - \frac{f1}{N}$$

$$\mathrm{CC} = 1 - \frac{\sum_{j=1}^{q} \left(\frac{1}{j}\right) fj}{N}$$

Where f_j indicates the number of papers having j authors in the collection, q represents the

maximal number of authors in a single paper, *N* is the total number of papers, and *n* is the total number of authors in the collection.

Moreover, the co-authorship matrices of authors and institutions in the *IJISM* were created in the Microsoft Excel environment. These collaboration networks at both the author and institutional levels were then analyzed using UCINet and VOSViewer softwares. Co-authorship networks are social networks constructed by connecting two or more authors or institutions together if they have co-authored an article. The co-authorship of papers creates a social network which can be studied in order to understand the characteristics of a particular field. Studies over the last decade have built on these foundations to demonstrate the efficacy using SNA to investigate co-authorship patterns. SNA is based on the premise that the relationships between actors (e.g. authors, institutions, countries) can be described by a visual representation in which nodes represent actors and links represent social interactions (e.g. co-authorship) (Benckendorff, 2010). In the current study, the SNA approach was carried out to describe collaboration networks in the journal on macro and micro-levels. Macro network metrics seek to describe the characteristic of a social network as a whole while micro metrics analyze the individual properties of network actors. In this study, we focused on four key elements of the network: density, components, geodesic distance and clustering coefficient. Moreover, we applied three centrality measures (degree centrality, closeness centrality and betweenness cenytrality) as well as three scientometric measures (number of publications, number of citations and number of collaborators) to investigate different contribution of actors in the co-authorship networks in *IJISM*. The following equations show the mathematical forms of centrality measures. The degree centrality of node *k (i.e., pk)* is defined as follows:

$$C_D(p_k) = \sum_{i=1}^{n} a(p_i, p_k)$$

where *n* is the number of nodes in the network and *a(pi, pk) = 1* if and only if node *i* and *k* (i.e., *pi* and *pk*) are connected; *a(pi, pk) = 0* otherwise. Additionally, closeness centrality of node *k (i.e., pk)* is defined as follows:

$$C_C(p_k) = \sum_{i=1}^{n} d(p_i, p_k)^{-1}$$

where *d(pi, pk)* is the geodesic distance (shortest paths) linking *pi* and *pk*. Finally, the betweenness of node *k (i.e., pk)* is formulated as follows:

$$C_B(p_k) = \sum_{i<j}^{n} \frac{g_{ij}(p_k)}{g_{ij}}; \quad i \neq j \neq k$$

where *gij* is the geodesic distance (shortest paths) linking *pi* and *pj* and *gij(pk)* is the geodesic distance linking *pi* and *pj* that contains *pk* (Abbasi, Hossain, & Leydesdorff, 2012).

Results and Discussion

Distribution of Papers by Year

The total of 173 articles published in *IJISM* during the period under study. Table 1 below presents the distribution of articles by publication year. The highest number of articles was published in 2010 with an output of 31 publications, followed by 26 articles in 2012 (Table 1).

Table 1

Distribution of Articles by Year

Year	No. of Articles	Cumulative No. of Articles
2003	14	14
2004	14	28
2005	12	40
2006	14	54
2007	17	71
2008	15	86
2009	15	101
2010	31	132
2011	15	147
2012	26	173
Total	173	173

Authorship Patterns of Papers Published in *IJISM*

Table 2 below reflects that 120 (69.3%) out of the 173 publications in *IJISM* are results of collaborative efforts. Among these co-authored papers, collaboration of two, three, four and five authors constitute 46.2%, 14.4%, 8% and 0.5% of the total publications, respectively. In contrast, 30.9% of all the papers published in *IJISM* during the period 2003-2012 were single-authored (table 2).

Table 2

Authorship Patterns of Papers Published in IJISM

Authorship Pattern	Frequency	Percent
1	53	30.9
2	80	46.2
3	25	14.4
4	14	8
5	1	0.5
Total	173	100

Collaboration Patterns of Papers Published in *IJISM*

An analysis of the distribution of publications output in *IJISM* indicates that most of the collaborative papers published in the journal (90%) have resulted from domestic collaboration (collaboration of authors affiliated with institutions from the same country), while international collaboration (collaboration of authors affiliated with institutions from different countries) only constituted 10% of the total collaborative papers. The total number of publications co-authored with inter- and intra-institutional collaborative author teams was also calculated. The findings revealed that 57% of publications were the result of author collaboration of the same institution (Inter-Institutional Collaboration) and 43% as a result of intra-institutional collaboration (table 3).

Table 3

Collaboration Patterns of Papers Published in IJISM

Collaboration Pattern	Frequency	Percent
Domestic Collaboration	109	90
International Collaboration	11	10
Total	120	100
Collaboration Pattern	**Frequency**	**Percent**
Inter-Institutional Collaboration	68	57
Intra-Institutional Collaboration	52	43
Total	120	100

Collaborative Measures in Papers published in *IJISM*

To show the trend toward multiple authorships in the journal, three indicators, namely Collaboration Index (CI), Degree of Collaboration (DC) and Collaboration Coefficient (CC), were studied in this paper. Collaboration Index (CI) is a measure of average number of authors per publication. As shown in table 4, the average number of authors who contributed to the papers in *IJISM* is 2. Degree of Collaboration (DC) which shows the proportion of co-authored publications in total publications is 0.69 in the papers published in *IJISM*. This finding clearly indicates the tendency of authors toward research collaboration. Finally, CC is the proportional mean of the sum of publications and number of authors. The CC lies between 0 and 1, with 0 corresponding to single-authored papers and 1 corresponding to maximal collaboration. This implies that the higher the value of CC, the higher the probability of multi-authored papers. The value of CC for papers published in *IJISM* is 0.4, which is much less than 1. This finding indicates that large share of papers published in *IJISM* are multi-authored (table 4).

Table 4

Collaborative Measures in the Papers Published in IJISM

Measure	Frequency
Collaboration Index	2
Degree of Collaboration	0.69
Collaboration Coefficient	0.4

Geographical Origin of Paper Published in *IJISM*

The contribution of different countries in papers published in *IJISM* was also investigated in this study. The geographic origin of the authors was determined for 173 publications. Based on the results, researchers from 22 countries of the world had publications in *IJISM*. Among them, Iran has published 134 papers during the examined years, followed distantly by UK (11) and Malaysia (5). The name and share of the contributing countries are shown in table 5.

Table 5

Share of Countries in the Papers Published in IJISM

Rank	Country	No. of Publications
1	Iran	134
2	UK	11
3	Malaysia	5
4	India	4
5	USA	3
6	Germany	3
7	Nigeria	2
8	Oman	2
9	Yemen	2
10	Bangladesh	2
11	France	2
12	Morocco	2
13	Australia	1
13	Czech Republic	1
13	Australia	1
13	Sri Lanka	1
13	China	1
13	UAE	1
13	Botswana	1
13	Switzerland	1
13	Jordan	1
13	Sweden	1

Co-authorship Network of Authors in *IJISM*

IJISM's collaboration network was first examined from the perspective of individual authors. Accordingly, the co-authorship network of authors in the journal of *IJISM* at the macro and micro levels was mapped and analyzed using UCINet software. Macro-level metrics concentrates on the topology features of a network as a whole with the aim to capture the overall structure of a network; while micro-level metrics focuses on the evaluation of individual actors with the aim to capture the features of each actor in a network (Benckendorff, 2010). The co-authorship network of authors consists of vertices and links: vertices represent authors, while links connect vertices in the form of co-authorships. There is a link between two vertices if they have co-authored at least one paper. The size of a vertex is proportional to the number of co-authorships that a given author has in the network. The network vertices consisted of the entire population of individual authors (n=265) who contributed to the 173 peer-reviewed articles published in *IJISM* in a decade. Within this network, 463 co-authorship ties exist between authors (Figure 1). The degree of connectedness of a network is given by the density measure, which is the proportion of actual linkages to possible linkages among actors. In other words, network density is defined as the number of links in a network, expressed as a proportion of the maximum possible links (Godley, Barron, & Sharma, 2011).The density of the co-authorship network of authors in *IJISM* is 0.006, which indicates only 0.6% of all possible links being present. The social relationships in such low density network tend to be large, open and diverse with externally focused relationships. The structure of such a spare network consists of many small components, suggesting that collaboration generally occurs across only a few articles

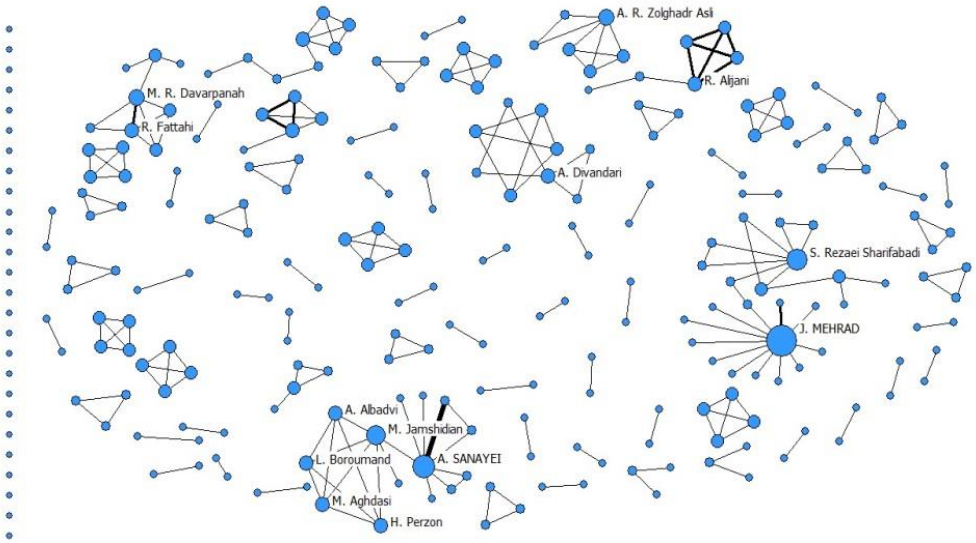

Figure 1. Co-authorship network of authors in *IJISM*.

Moreover, in order to get an overall overview of the general structure of the network as

well as to draw attention to the dense areas in the map, density view of the network was visualized using the VOSViewer software (Figure 2). In this map, each vertex has a color that depends on weight of vertex in the network, number of vertices in the neighborhood and the importance of the neighboring vertices.

The larger the number of vertices in the neighborhood of a vertex and the higher the weights of the vertices, the closer the color of the point is to red. Conversely, the smaller the number of vertices in the neighborhood of a point and the lower the weights of the vertices, the closer the color of the vertex is to blue. To put in another way, colors indicate the density of vertices, ranging from blue (lowest density) to red (highest density). Authors who are located in dense areas of the map are shown in red, clearly indicating their important structural role in the co-authorship network of authors in *IJISM*.

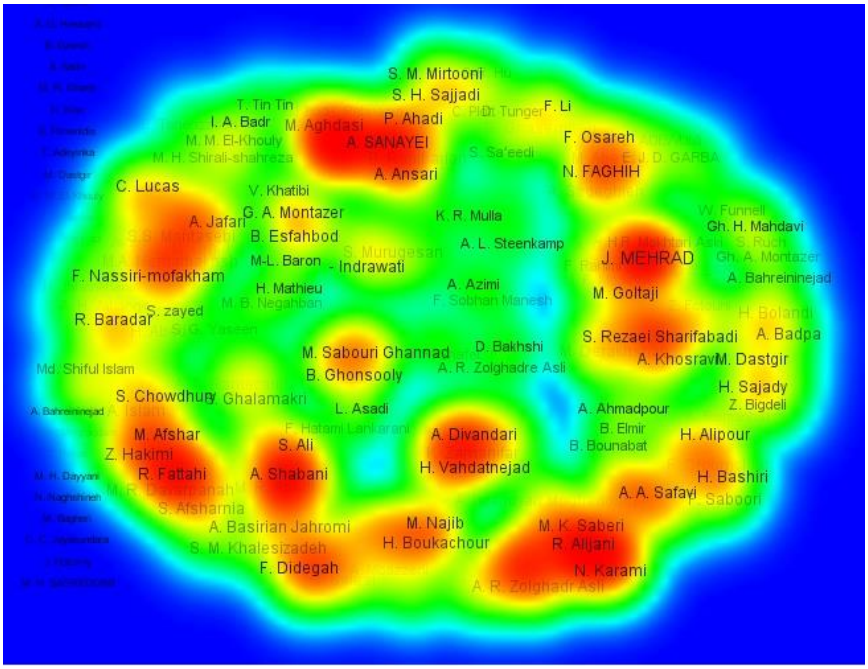

Figure 2. Density view screenshot of the co-authorship network of authors in *IJISM*.

Similar to many other networks, the co-authorship network of authors in *IJISM* is composed of one large component (known as main, giant or core component) and many small components. Each set of connected authors in Figure 1 represents one component of a network structure. A component is a connected subset of a network in which there are direct or indirect links between all vertices (Krichel & Bakkalbasi, 2006). The co-authorship network of authors in *IJISM* consists of 107 components, the largest of which contains only 24 vertices, yielded a ratio of 9% of the whole network. Some other researchers who have little communications with the external research community form small components in the network (Figure 3). In total, the co-authorship network of authors in *IJISM* comprised 34 isolates (vertices with degree centrality of zero), 40 dyads (vertices with degree centrality of

one), and 31 components of between 3 and 8. The geodesic distance between two vertices is defined as the number of lines or steps on the shortest path that connects them (Newman, 2004). The UCINet calculation results show that the mean geodesic distance between two vertices in the co-authorship network of authors in *IJISM* is 2.15, which means that in this network, only an average of 2.15 steps are necessary to get from one randomly chosen vertex to another in the main component. According to this finding, the famous notion of "six degree of separation" can be valid in this network. Travers and Milgram (1969) found that for a large well-connected network, each vertex can reach any other vertex through a small number of links. They claimed that there are no more than six connections between any two people on this planet.

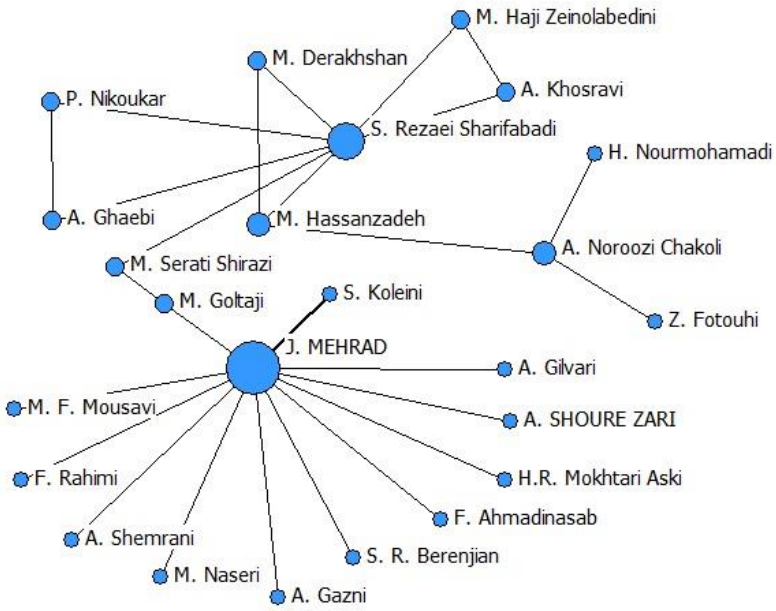

Figure 3. Main component of *IJISM* co-authorship network.

Another network topology attribute, the clustering coefficient, indicates the extent to which vertices in a network tend to cluster together (Newman, 2004). It describes the probability that two of a scientist's collaborators have themselves co-authored a paper. Considering all vertices of the network, the total clustering coefficient is 0.654, which indicates that the network is highly clustered. As a result, two authors typically have a high probability of collaboration (65.4%) if both have collaborated with a third author. The short mean distance coupled with high clustering coefficient indicates that the co-authorship network of authors in *IJISM* seems to exhibit "small world" network properties. A "small world" is a network in which any two vertices are only a few steps apart, regardless of network size. In this network, vertices are not necessarily all connected to each other, yet they are easily reachable from one another via short path (Watts & Strogatz, 1998).

Micro-level metrics refers to centrality, which is one of the most important and frequently

used measurements in social network analysis. Centrality measures indicate how central the actor is to the network, which offer a useful perspective for assessing researcher's performance according to their functions and roles in the network (Benckendorff, 2010). Three common centrality metrics, namely degree centrality, closeness centrality and betweenness centrality were adopted to analyze the co-authorship network of authors in *IJISM*. Table 6 presents the top 15 authors in terms of centrality measures (degree, betweenness and closeness), productivity (number of papers published in *IJISM*), citation impact (number of citations received till July 2013 according to the Google Scholar) as well as collaboration (number of co-authors).

Table 6

Top 15 Authors in Centrality, Productivity, Citation Impact and Collaboration

Rank	Productivity		Citations		Collaborators		Degree		Betweenness		Closeness	
	Author	Freq.	Author	Freq.	Author	Freq.	Author	Freq.	Author	Freq.	Author	Freq.
1	Mehrad	15	Sanayei	13	Mehrad	12	Mehrad	13	Mehrad	0.0076	Mehrad	0.00388
2	Sanayei	12	Salahshoor	12	Sanayei	8	Sanayei	10	Rezaei	0.0050	Goltaji	0.00388
3	Rezaei	5	Jafari	12	Jamshidian	6	Alijani	7	Goltaji	0.0041	Serati	0.00388
4	Montazer	4	Mehrad	11	Rezaei	6	Rezaei	6	Serati	0.0037	Rezaei	0.00388
5	Dayani	4	Dastgir	11	Zolghadr	5	Karami	6	Sanayei	0.0035	Hassanzadeh	0.00387
6	Jamshidian	4	Hashem Nejad	10	Alijani	4	Khasseh	6	Jamshidian	0.0025	Shoure Zari	0.00387
7	Alijani	4	Jahankhani	10	Fattahi	4	Mooghali	6	Hassanzadeh	0.0022	Gazni	0.00387
8	Faghih	3	Sajady	10	Boroumand	4	Shabani	6	Chakoli	0.0016	Koleini	0.00387
9	Chakoli	3	Isfandyari	9	Aghdasi	4	Jamshidian	6	Erfanmanesh	0.0006	Mousavi	0.00387
10	Zolghadr	3	Steenkamp	8	Albadvi	4	Abedi	5	Didehgah	0.0006	Mokhtari	0.00387
11	Shabani	3	Mousa Basal	8	Perzon	4	Fattahi	5	Basirian	0.0005	Gilvari	0.00387
12	Osareh	3	Saberi	8	Didehgah	4	Zolghadr	5	Davarpanah	0.0004	Rahimi	0.00387
13	Jahankhani	3	M. Esmaeel	8	Divandari	4	Davarpanah	4	Khalesizadeh	0.0003	Naseri	0.00387
14	Fattahi	3	Parirokh	6	Shabani	4	Didehgah	4	Alijani	0.0003	Shemrani	0.00387
15	Hayati	3	Mashinchi	6	50 Authors	3	Ansari	4	Afsharnia	0.0003	Berenjian	0.00387

We found that 265 authors contributed 173 papers published in *IJISM* during 2003-2012. Of these, only 12 authors contributed 5 or more papers, while 219 authors only contributed one paper in *IJISM.* Given that editorial board members of the journals are considered to be among the most productive and prestigious authors (Campanario, 1998), the results show that Professor Jafar Mehrad, founder and president of *RICeST* and editor in chief of *IJISM,* has published the largest number of papers (15), followed by A. Sanayei (12) and S. Rezaei (5). Here, we simply assumed that the number of published articles in the journal represented the productivity of a particular author. The citation impact of authors published in *IJISM* has also

been measured through their total number of citations in the Google Scholar. The number of citations a researcher receives is an indication of influence of individuals and reflects the impact of authors in the research community (Garg & Padhi, 2002). Based on the results, 173 papers published in the journal received a total number of 184 Google Scholar citations by July 2013. The results show that 64 papers have received 1 to 12 citations, while other 109 papers have not garnered any citations since their publication. The top 15 highly cited authors, ranked by the frequency of citations, are listed in Table 6. As this table shows, A. Sanayei is the most cited author (13), followed by K. Salahshoor and M.R. Jafari (12). The average citations per paper for the overall publications output of the IJISM during 2003 to 2012 was only 1.06.

Scientific collaboration of authors was also studied using the SNA approach, with the aim of capturing the features of each actor in the network using centrality metrics. Three centrality metrics (degree centrality, closeness centrality and betweenness centrality) were adopted to analyse the co-authorship network of authors in the *IJISM*. Authors with a higher degree centrality (more co-authorship) are more central to the structure of the network and tend to have a greater capacity to influence others. The average degree centrality of authors in *IJISM* co-authorship network is 1.74, while the degree distribution varies significantly. The results show a strong power-law distribution with a few authors showing a high degree centrality and the majority of authors having a very low degree centrality. In a dataset of 265 authors, only 12 authors have a degree centrality of 5 or more. J. Mehrad reaches the highest degree centrality of 13, followed by A. Sanayei (10) and R. Alijani (7). The authors with very high degree centrality are considered as the most important and influential authors with the highest extent of collaboration because they are crucial to the robustness of the network as well as the transmission of information. The centrality of these authors stems from the implied strategies of co-authoring multiple publications with the same collaborators, co-authoring with a greater number of different co-authors, or some of both.

How close an author is on average to all others in the network is determined through closeness centrality. This measure can be interpreted as an indicator of the influence of an actor because the higher its value, the easier for that actor to obtain and spread information through the network (Martinez-Romo et al., 2008). Table 6 shows the top 15 authors ranked on the standardized closeness centrality measure. The top scorers in terms of closeness are: J. Mehrad, M. Goltaji, M. Serati and S. Rezaei (0.00388). Since closeness centrality measures the distance of an individual to all others in the network, the closer an individual is to others, the more favoured that individual is. It is also noteworthy that if an author co-authored with authors having high closeness centrality, this author would also have a high closeness centrality; however, he/she may have low academic productivity or impact. In the current study, M. Goltaji and M. Serati have only published two and one paper in *IJISM* respectively, but co-authoring with J. Mehrad provided them with high closeness centrality measures in the

network.

Table 6 also shows the top 15 authors with the highest betweenness centrality. Authors with high betweenness centrality are deemed highly central because they control the flow of information in the network (Racherla & Hu, 2010). The betweenness centrality scores indicate that J. Mehrad (0.0076), S. Rezaei (0.0050) and M. Goltaji (0.0041) have the most favoured positions in the network by falling on the geodesic paths between other pairs of authors. The network without brokers with high betweenness centrality would display greater fragmentation into separate unconnected components. However, authors with either no or only one co-authorship, have betweenness centrality score of zero. The total number of people with whom an author collaborated directly was also calculated. The researchers with the highest number of collaborators are likely to be more active and influential in the academic community. The most connected author in the network is J. Mehrad who has 12 different immediate co-authors, followed by A. Sanayei (8), M .Jamshidian and S. Rezaei (6). Reviewing Table 6, we can see that a few researchers like J. Mehrad, A. Sanayei and S. Rezaei are ranked high in most of the measures, clearly indicating their important structural role in the network.

Co-authorship Network of Institutions in *IJISM*

Using the affiliations listed for each author, the paper analysed the co-authorship network of institutions in *IJISM*. All authors from the same institution are aggregated into a single network vertex, while links represent a co-authorship between two different institutions. Similar to the previous network figure, the size of a node denotes the number of articles that a given node published in the journal. Based on the institutional collaboration network shown in Figure 4, institutions with the highest degree centrality are identified. While 81 unique institutions are presented by published articles in *IJISM* network, 55 of these institutions have 101 cross-institutional collaboration links. A total of 26 institutions are isolated, having no collaboration with the rest of the network, and 22 institutions have only a single link in the network (pendants). With a very low density of 0.0015, the co-authorship network of institutions demonstrates low cohesion. The giant component of the network comprises 33 institutions which occupies 40% of the overall size of the network. Similar to the author collaboration network, the institution network demonstrates a highly peripheral structure with isolate and dyadic ties.

Micro level metrics which include degree centrality, closeness centrality and betweenness centrality as well as productivity and collaborations were also calculated for institutions co-authorship network. It is also worth noting that the centrality, productivity and collaboration of an institution are largely related to the individuals who are affiliated with that institution. In other word, institutional centrality within collaboration network emerges and develops as authors affiliated with that institution create co-authoring links. For example, J. Mehrad plays

a vital role in increasing the centrality of the *RICeST* as well as *Shiraz University*, just like the role of A. Sanayei at Isfahan University. The results show that the most productive institutions have established collaborative links with a great number of institutions. When all of the metrics are examined together, it is clear that there are important institutions strategically positioned in the network due to their centrality, productivity as well as collaboration. These institutions are *Shiraz University, Isfahan University, RICeST, Alzahra University, Tarbiat Modarres University* and *Ferdowsi University of Mashhad.*

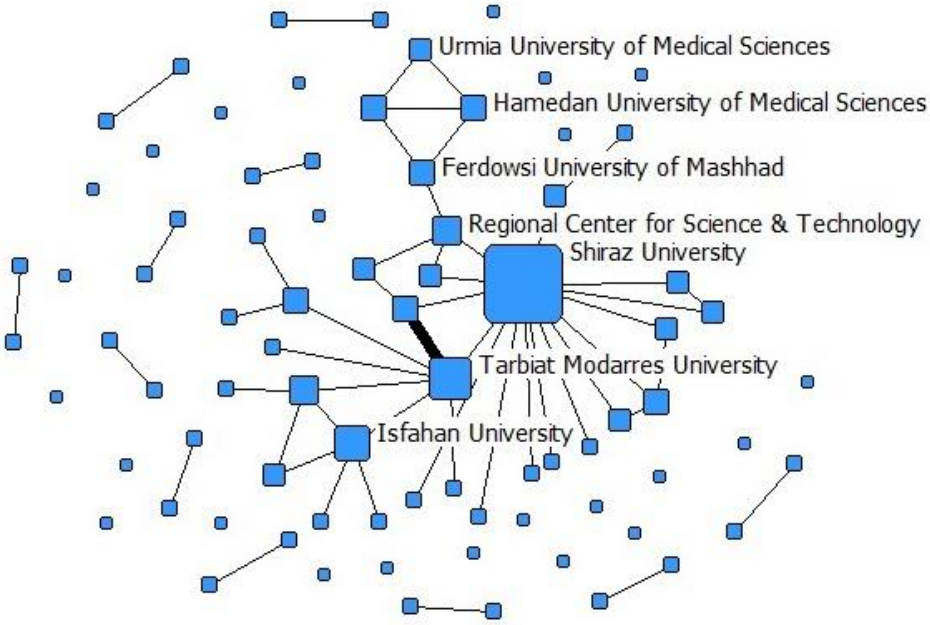

Figure 4. Co-authorship network of institutions in the *IJISM*

Conclusion

This study has examined the performance of the *International Journal of Information Science and Management (IJISM)* over a 10-year period from 2003 to 2012 using scientometric approach. Moreover, compared with the previous study conducted by Mulla (2011), the current study characterized the *IJISM's* collaboration network at the author and institutional levels using Social Network Analysis measures. In addition, we have identified the most important vertices (authors and institutions) in the *IJISM* collaboration network and have observed them from several points of view (centrality measures, productivity, citation impact and collaboration). The key findings of the study are:

a) The study reveals that the total of 173 articles was published in *IJISM* during 2003-2012. The highest number of articles was published in 2010 with an output of 31 publications. The range of articles published per volume during the period under study is between 12 and 31.

b) Multi-authored papers far outnumbered single-authored papers, comprising 79% of the total articles published in *IJISM*.

c) The number of papers written in inter-institutional collaboration (68) is slightly more than the number of papers written in intra-institutional collaboration (52).

d) The number of publications with domestic author teams (109) is significantly higher than the number of publications with international author teams (11).

e) Results show that *IJISM* collaboration network is a "small world network" by demonstrating its short mean distance and scale free properties.

f) Two measures (density and clustering coefficient) which have been used to investigate the cohesion of the network indicate relatively loose structure of the *IJISM* network with only a few close relations. This might be the result of the fact that authors would prefer to collaborate in small regional research groups.

g) *IJISM* network contains a wide range of collaborations and a large set of participants from various academic backgrounds which indicate the interdisciplinary nature of information science and management.

h) The co-authorship network of authors in *IJISM* appears to be quite dispersed, with a high number of unconnected components (106) and is dominated by one main component which contains 24 vertices.

i) Prolific researchers like J.Mehrad, A. Sanayei and S. Rezaei are ranked high in most of the studied measures, indicating their critical role in the production of *IJISM* papers. They are also strategically positioned in the network due to their centrality. It is noteworthy that the central and productive authors are mostly affiliated with Iranian academic institutions.

j) The structural properties of *IJISM* network indicate the existence of a potential problem with the community. As the network is dominated by just a few number of key researchers (rather than quite a significant number), removing these individuals from the community (because of retirement, etc.) will cause it to fall apart. According to the "preferential attachment" principle which was proposed by Barabasi and Albert (1999), new authors prefer to attach to well-connected and central authors. Therefore, the prolific, productive and central individuals in the *IJISM* community should attract new members to produce new generations of high impact researchers.

k) The most productive authors in *IJISM* have also established collaborative links with a great number of authors. Accordingly, those productive authors with a high degree centrality are likely to have more immediate neighbours or collaborators.

l) Results of the study reveal that most of the international contributions come from the Asian, European and African countries, while there were only 3 contributions from the North America.

m) Shiraz University, Isfahan University, RICeST, Alzahra University, Tarbiat Modarres University and Ferdowsi University of Mashhad occupy the topmost productivity, citation impact and centrality rankings, which indicate their role in publication of *IJISM*.

n) The paper demonstrates that research impact and influence cannot be measured in

terms of papers and citations alone and the visual collaboration networks presented in this paper utilized a number of alternate metrics for measuring the contribution of authors and institutions in a journal.

While the 10-year-old *IJISM* collaboration network presently reflects a peripheral structure with low cohesion, few bridging ties, and few brokering authors, it will evolve and mature in the years to come. The results of this study allow journal's editorial board to step back and look at the performance of the journal over a decade. A more detailed study might track the performance of the journal using other scientometric and SNA measures. Likewise, it would be instructive to compare *IJISM* co-authorship network with other domestic and international LIS journals.

References

Abbasi, A., Hossain, L. & Leydesdorff, L. (2012). Betweenness centrality as a driver of preferential attachment in the evolution of research collaboration networks. *Journal of Informetrics*, *6*(3), 403-412.

Al-Ghamdi, A., Al-Harbi, M., Beacom, N.A., Dedolph, J., Deignan, M., Elftmann, C., & Withers, B. (1998). Authorship in JASIS: A quantitative analysis. *Katherine Sharp Review*, *6*, 1-13.

Bakry, W. & Willett, P. (2008). The Malaysian Journal of Library and Information Science 2001-2006: A bibliometric study. *Malaysian Journal of Library & Information Science*, *13*(1), 103-116.

Barabasi, A.L., & Albert, R. (1999). Emergence of scaling in random networks. *science*, *286*(5439), 509-512.

Benckendorff, P. (2010). Exploring the limits of tourism research collaboration: A social network analysis of co-authorship patterns in Australian and New Zealand tourism research. *In proceeding of the 20th Annual CAUTHE Conference*, Hobart, Astralia.

Bharvi, D., Garg, K.C. & Bali, A. (2003). Scientometrics of the international journal Scientometrics. *Scientometrics*, *56*(1), 81-93.

Campanario, J.M. (1998). Peer review for journals as it stands today – Part 1. *Science Communication*, *19*, 181-211.

Chaurasia, K.K. (2008). Bibliometric analysis of Annals of Library and Information Science (2002-2006). *Proceedings MANLIBNET 9th Annual National Convention*, New Delhi, India. Retrieved 7 July, 2013 from: http://eprints.rclis.org/11756/1/annals.pdf.

Chen, Y.W., Fang, S. & Borner, K. (2011). Mapping the development of scientometrics: 2002-2008. *Journal of Library Science in China*, *3*, 131-146.

Erfanmanesh, M., Rohani, V. A. ,& Abrizah, A. (2012). Co-authorship network of scientometrics research collaboration. *Malaysian Journal of Library & Information Science*, *17*(3), 73-93.

Garg, K.C. (2003). An overview of cross-national, national, and institutional assessment as reflected in the international journal Scientometrics. *Scientometrics, 56*(2), 169-199.

Garg, K.C. & Padhi, P. (2002).Scientometrics of laser research in India during 1970-1994. *Scientometrics*, *55*(2), 215-241.

Godley, J., Barron, G. & Sharma, A.M. (2011). Using social network analysis to assess collaboration in health research. *Journal of Healthcare, Science & the Humanities, 1*(2), 99-116.

Harter, S.P. & Hooten, P.A. (1992). Information science and scientists: JASIS, 1972-1990. *Journal of the American Society for Information Science*, *43*(9), 583-593.

Hou, H., Kretschmer, H. & Liu, Z. (2008). The structure of scientific collaboration networks in Scientometrics. *Scientometrics*, *75*(2), 189-202.

Krichel, T. & Bakkalbasi, N. (2006). *A social network analysis of research collaboration in the economic community*. Paper presented at the International Conference on Webometrics, Informetrics & Scientometrics, Nancy, France.

Liao, C.H., & Yen, H.R. (2012). Quantifying the degree of research collaboration: A comparative study of collaborative measures. *Journal of Informetrics*, *6*(1), 27-33.

Lipetz, B. (1999). Aspects of JASIS authorship through five decades. *Journal of the American Society for Information Science & Technology*, *50*(11), 994-1003.

Liu, J. (2003). A bibliometric study: Author productivity and co-authorship features of JASIST 2001-2002. *Mississippi Libraries*, *67*(4), 110-112.

Martinez-Romo, J., Robles, G., Gonzalez-Barahona, M., & Ortuno-Perez, M. (2008*).* Using social network analysis techniques to study collaboration between a FLOSS community and a company. *In Russo, B. et al. (Eds.), IFIP International Federation for Information Processing, Volume 275: Open Source Development, Communities and Quality* (pp. 171-186). Boston, Springer.

Meadow, C.T. ,& Zaborowski, M.A. (1979). Some statistical aspects of JASIS publications. *Journal of the American Society for Information Science*, *30*(6), 368-371.

Mehrad, J. ,Nowrouzi Chakeli, A.,& Dayani, M.H. (2008). RICeST: It's origin and development, An interview with Prof. Jafar Mehrad. *International Journal of Information Science & Technology, 6* (1), 1-8.

Mulla, K.R. (2011). Mapping of the International Journal of Information Science and Management (2003-2009): A citation study. *International Journal of Information Science & Management, 9* (1), 1-17.

Naqvi, S.H. (2005). Journal of Documentation: A bibliometric study. *International Information Communication & Education*, *24*(1), 53-56.

Naseer, M.M. & Mahmood, K. (2009). LIS research in Pakistan: An analysis of Pakistan Library and Information Science Journal 1998-2007. *Library Philosophy & Practice,2009,* 1-10. Retrieved from http://www.webpages.uidaho.edu/~mbolin/naseer-

mahmood.htm.

Newman, M.E.J.(2004). Co-authorship networks and patterns of scientific collaboration. *Proceedings of the National Academy of Science of the United States of America*, *101*(1), 5200-5204.

Racherla, P. & Hu, C. (2010). A social network perspective of tourism research collaboration. *Annals of Tourism Research*, *37*(4), 1012-1034.

Rosy, J. (2009). Citation analysis of Library Trends. *Webology*, *6*(1), 67. Retrieved from http://www.webology.ir/2009/v6n1/a67.html

Tiew, W.S., Abdullah, A., &, Kaur, K. (2002). Malaysian Journal of Library and Information Science 1996-2000: A bibliometric study. *Malaysian Journal of Library & Information Science, 6* (2), 43-56.

Travers, J., & Milgram, S. (1969). An experimental study of the small world problem. *Sociometry*, *32*(4), 425-443.

Watts, D. and Strogatz, S.H. (1998). Collective dynamics of small-world networks. *Nature*, 393, 440-442.

Young, A.P. (2006). Library Quarterly, 1956-2004: An exploratory bibliometric analysis. *Library Quarterly*, *76*(1), 10-18.