BIBLIOMETRIC ANALYSIS ON SCIENTIFIC RESEARCH ON INNOVATION DIFFUSION

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Abstract: Innovation diffusion has become a large and growing field with considerable amount of publications as the pioneering studies have appeared in the literature. In this context, the main purpose of this paper is to analyze the scientific publications on innovation diffusion by providing basic statistics (distributions of publications by document types, publication years, authors' origins, and etc.) and distinct trends in publication topics. With this purpose, a bibliometric analysis will be performed for a total of 900 papers published between January 1, 1981 and December 5, 2013. The findings of the study are expected to be helpful and insightful for understanding the current state and trends of research on innovation diffusion and thereby guiding researchers for their future studies.

Keywords: Bibliometric Analysis, Innovation, Diffusion.

Introduction

Innovation diffusion has generally been defined as *the process by which an innovation is communicated through certain channels over time among members of a social system* (Rogers, 2003). The theory of innovation diffusion simply explains how new ideas, technologies, and practices spread within a social system (Bohlmann, Calantone, and Zhao, 2010, Peres, Muller, and Mahajan, 2010, Valente and Davis, 1999). This theory originates in anthropology and sociology ("The laws of imitation" 2016) with some principles adapted from epidemiology (Bailey, 1975, Valente and Davis, 1999). In time, it has spread to several different research areas.

The modeling and forecasting of the innovation diffusion introduced to marketing area when the pioneering studies of it started to appear in 1960s. After its introduction to marketing, the theory of innovation diffusion has sparked considerable research among consumer behavior, marketing management, and management and marketing scholars (Mahajan, Muller, and Bass, 1990). Several different models for innovation diffusion have been built in order to investigate the diffusion of new ideas, technologies and practices.

In 1969, Bass presented a diffusion model that is one of the most popular diffusion models, has been widely used for investigating the diffusion process of innovation in a social system (Cho and Koo, 2012). Since the publication of the Bass model, the researchers on the modeling of innovation diffusion has set a vast literature consisting of several dozens of articles, books, and assorted other publications (Mahajan, Muller, and Bass, 1990). Correspondingly, innovation diffusion has become a large and growing field by numerous researchers across multiple disciplines with the primary objective of understanding the mechanism that motivate the innovation and diffusion process (Rogers, 2003). In this context, the main objective of the present paper was to perform a bibliometric analysis on the vast bodies of literature of innovation diffusion in order to find the basic statistics (distributions of publications by document types, publication years, author numbers, authors' origins, and research areas) and examine hot topics and trends of them.

For this study, publications on innovation diffusion were collected from Web of Knowledge database. Also, the time period of the publications was restricted from January 1, 1981 through December 5, 2013.
The rest of this paper was structured as follows. Section 2 provided information for used methodology and the data collection process. Section 3 presented the results of the analysis by several dimensions. Lastly, section 4 concluded the present study

Materials and Methods

In this study, a bibliometric analysis was performed for investigating the publications on innovation diffusion. Bibliometric analysis (the quantitative analysis of publications) is particularly an applicable method for the fields with vast bodies of literature which are difficult to analyze by traditional review methods (Belter and Seidel, 2013). This method is a considerable part of reference and research services (Song and Zhao, 2013) and utilizes quantitative analysis and statistics to get the bibliographical works within a given area, topic, and etc. (Wallin,

2005, Jiang Tan, 2014, Zyoud, Al-Jabi, and Sweileh, 2014). It is also a useful method for getting a clear picture of the current state of the scientific researches in particular fields and allocates researchers to recognize and undertake new lines of researches (Battisti and Salini, 2012, Zyoud, Al-Jabi, and Sweileh, 2014). Due to the practicability of the method, it has been used large amounts of publication for several different research topics. Some examples for these studies are given in table 1. In the present study, this method is applied for innovation diffusion topic.

The current analysis focused on the scientific publications on innovation diffusion. For this study, the term "*innovation diffusion*" was searched in the topics of the publications that exist in the Web of Knowledge database. More than 950 papers were found for this search key in the selected database. However, the search was restricted by some criteria. These are given below.

- The papers were restricted by document types. Only articles and proceeding papers were included for the study.
- Publication years of the papers were also limited from January 1, 1981 through December 5, 2013 due to the lack of access to full texts and abstracts for previous papers
- Lastly, the papers that did not have abstracts available, is not included in this study.

Table 1: Examples of bibliometric analysis studies in the literature.

Reference Number	*Title*	*Topic*
(Zyoud, Al-Jabi, and Sweileh, 2014)	Bibliometric analysis of scientific publications on waterpipe (narghile, shisha, hookah) tobacco smoking during the period 2003-2012	Tobacco smoking
(Belter and Seidel, 2013)	A bibliometric analysis of climate engineering research	Climate Engineering
(Fu etc., 2010)	A bibliometric analysis of solid waste research during the period 1993-2008	Solid Waste
(Kim and McMillan, 2008)	Evaluation of internet advertising research: a bibliometric analysis of citations from key sources	Internet Advertising
(Falagas, Karavasiou, and Bliziotis, 2006)	A bibliometric analysis of global trends of research productivity in tropical medicine	Productivity in Tropical Medicine
(Mela etc., 2003)	Radiological research in Europe: A bibliometric study	Radiology

After these arrangements, 900 articles were found and downloaded from the database to analyze for the present study. The document types, publication years, author numbers, countries of author(s), and research areas of the downloaded documents were collected.

Results

This section of the present paper stressed on the general findings of the analysis that was performed for chosen publications. The results of the analysis were presented under the titles of *document types, publication years, research areas, author number, countries of authors,* and *abstracts* respectively.

By Document Types

A total 900 publications were analyzed for document types in this study. The document types of the publications were restricted as only article and proceeding paper at data collection process. Correspondingly, there are only two different types of documents for this analysis. Figure 1 presents the distribution of the analyzed publications according to document types.

The 665 of all publications (74% of all papers) consists of articles while the remaining 235 of the all papers (26% of all papers) were the proceeding papers. As seen in the figure 1, the large amounts of the papers (74% of the analyzed papers) have been prepared as articles. This may show us that researchers generally focus on producing articles for innovation diffusion topic all over the world
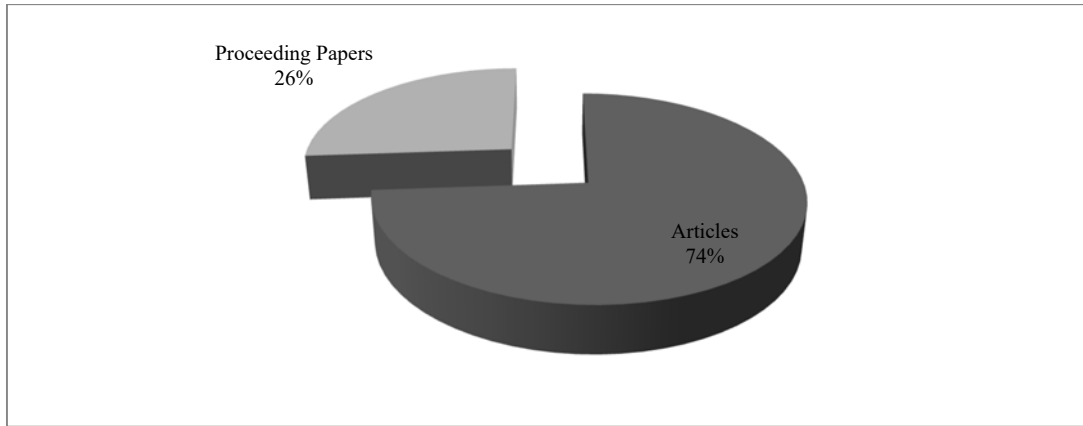
Figure 1. Distribution of the analyzed papers by document types.

By Publication Years

The publication years of the papers were restricted from January 1, 1981 through December 5, 2013. Figure 2 shows the annual distributions of the analyzed publications and figure 3 represents the number of papers in five years ranges. As seen in figure 2, the number of papers published on innovation diffusion was really low at the beginning years of the research time period. For example; only 5 papers were published from the beginning of 1981 to the end of 1985. And all of them were prepared as articles.

From 1986 to 1990, the number of papers increased to 16. Among these papers, there was still no proceeding paper to our knowledge. 59 papers were published on innovation diffusion. One of them was a proceeding paper within the range 1991-1995.
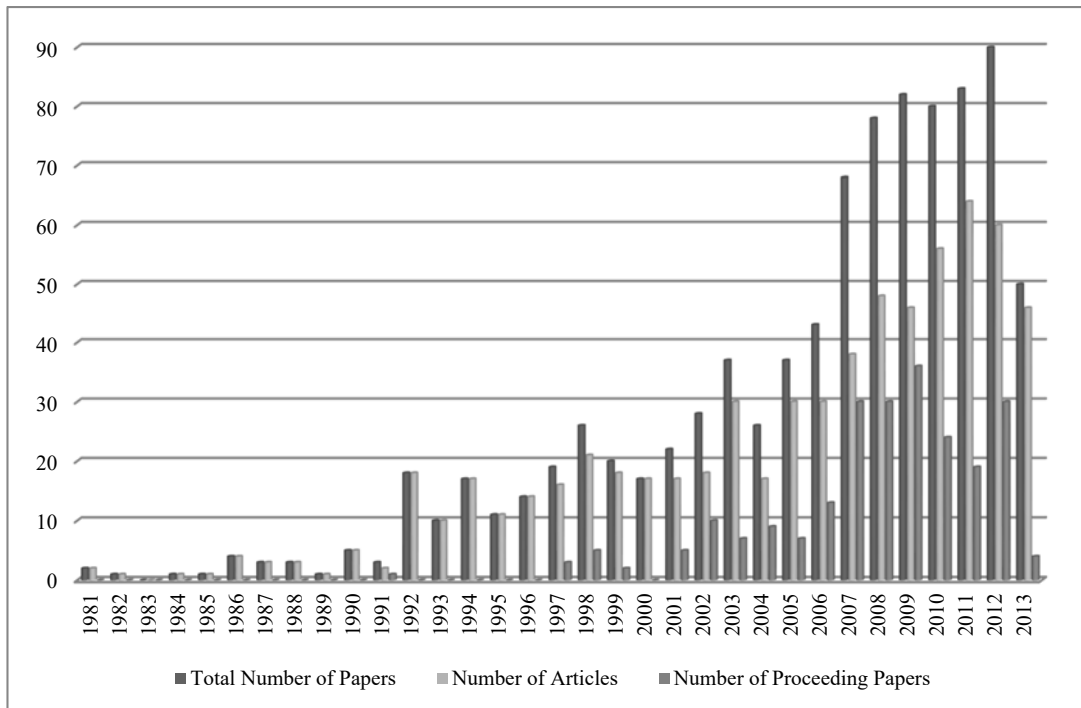

Figure 2. Annual distribution of the papers on innovation diffusion.

By Research Areas

The research areas were categorized in five main groups similar to the categorization of Web of Knowledge in this paper. The areas are: arts & humanities, life sciences & biomedicine, physical sciences, social sciences, technology.
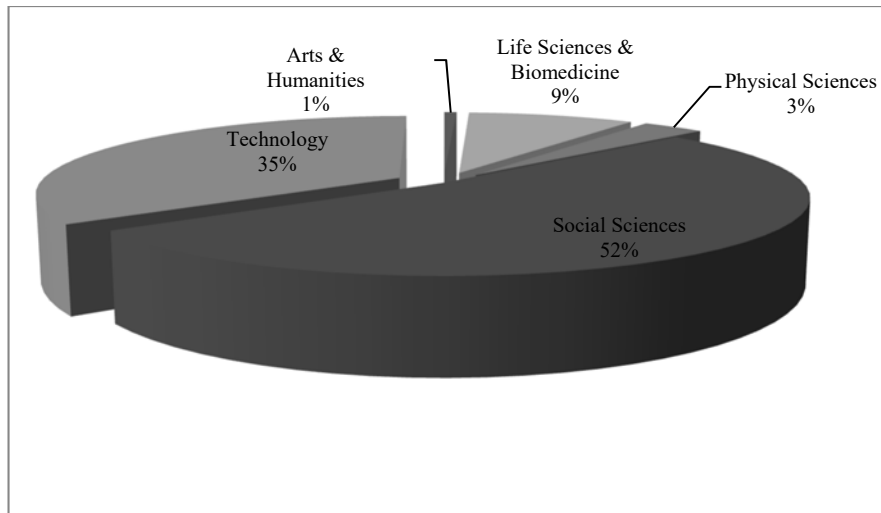
Figure 3. Distribution of the analyzed papers according to research areas.

During data collection process, the research areas of each paper was also recorded from the searched database and analyzed for the given period of time.

Figure 3 presents the distribution of the papers by research areas. As seen in the figure 5, 52% of the analyzed papers were related with social sciences. The social sciences area includes topics like Business & Economics; Psychology; Public Administration; Education; etc. according to the categorization of the selected database. The percentage of the papers for social sciences may show that the innovation diffusion researchers mostly focused on the social sciences areas for the given period.

The researches about technology field followed the social sciences area with 35%.   Thus, the largest amounts of the papers were related with social sciences and technology areas with 88%. Apart from these two areas, papers were distributed to life sciences & biomedicine with 9%, physical sciences with 3%, and arts & humanities research areas with 1% of all papers.

By Number of Authors
In this study, the papers were also analyzed for the number of authors. A total of 2136 authors participated in innovation diffusion related studies. The range of the authors was within 1 to 14. Average number of authors per paper is 2,373.

Figure 4 gives the distribution of the papers according to the number of authors. The 343 of the analyzed papers were prepared by two authors. The papers with three authors followed them with 225 of all papers. And, 214 of the papers were made by one author.

The remaining of the papers was prepared by four or more authors. However, the amount of papers with more than three authors showed considerable decrease. Correspondingly, the biggest amount of the papers (86% of all papers) was written one, two, or three author(s).
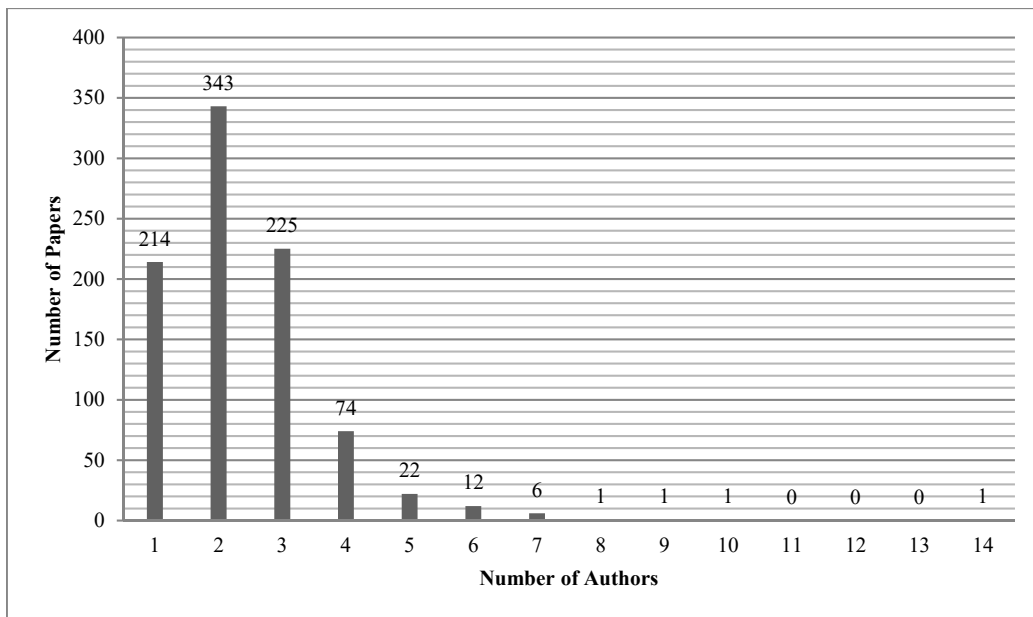
Figure 4. Distribution of the analyzed papers by number of authors.

By Countries of Authors

The analyzed publications were written by a total of 2136 authors from 68 different countries. It should be noted that the country knowledge of the authors were based on the correspondence addresses of the papers. The authors who did not give information about the origin of themselves were accepted as *unknown* in the analysis.

Figure 5 shows the percentage distribution of countries of authors. Authors originating from USA (United States of America) had the largest amount of the publications with 26% (with 568 papers). Authors originating from China ranked as the second with 11% (with 233 papers). Taiwan (Republic of China) had the third place for authors' origins with 9% (with 201 papers). Taiwan was followed by England, Italy, and Australia with 6%, 5%, and 4% respectively. More than the half (52% of all authors) of all authors was from the first four countries: USA, China, Taiwan, and England.
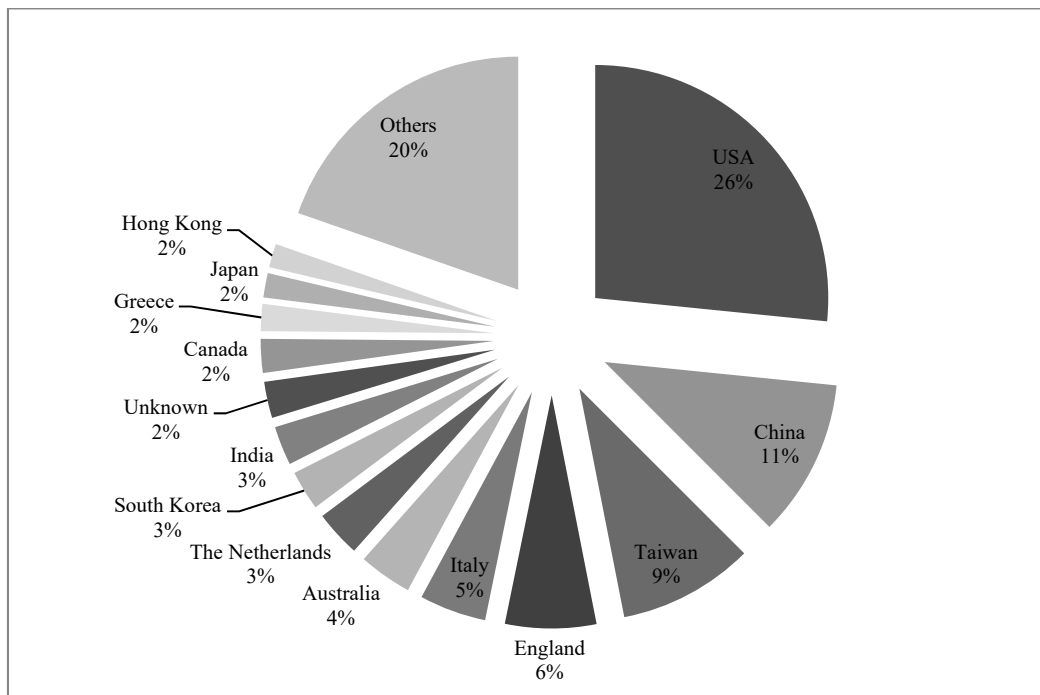

Figure 5. Percentage distribution of country origins of authors.

Conclusion

This paper mainly investigated the statistical distribution of the papers published about innovation diffusion in Web of Knowledge database from January 1, 1981 through December 5, 2013.

A bibliometric analysis was performed in order to compute basic statistics and examining the current state, hot topics and trends of innovation diffusion researches. The main findings of the present work are given below.

- The 665 of all publications (74% of all papers) consisted of articles while the remaining 235 of the all papers (26% of all papers) were the proceeding papers.
- The number of papers published on innovation diffusion was really low at the beginning years of the research time period. It showed a considerable increase at 1992 and fluctuated until 2000. The largest amount of the analyzed papers (724 of 900 papers) was written after 2000. And it peaked at 2012 with 90 papers.
- The biggest amount of the papers (52% of all papers) was related with social sciences research area. The papers related with Technology research area followed it with 35%.
- The biggest amount of the papers (86% of all papers) was written one, two, or three author(s).
- 900 papers were written by 2136 authors from 68 different countries.
- Authors originating from USA (United States of America) ranked to the first place with 26% (568 of all papers). Authors originating from China had the second place with 11% (233 of all papers). Taiwan (Republic of China) had the third place for authors' origins with 9% (201 of all papers). More than the half (52%) of all authors was from USA, China, Taiwan, and England respectively

The findings given in this study present some basic statistics and trends obtained innovation diffusion papers for the given period. However, the analyses in this study were subject to certain limitations. First, the document types of the papers were restricted as articles and proceeding papers. Second, the papers that did not have abstracts available online were not included in this study. Correspondingly, future researches may perform a more detailed study taking these limitations of the present study into account.

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