Chapter 1

Introductory Chapter: Scientometrics

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1. Introduction

Scientometrics has been defined as the "quantitative study of science, communication in science, and science policy" [1]. Over 20 years have passed since Hess's definition and now it has been used in many different fields. As representative works in the field of scientometrics, we can refer the Science Citation Index (SCI) [2, 3], the first Academic Ranking of World Universities (ARWU) of the Shanghai Jiao Tong University in 2004 [4], the h-index [5], g-index [6], and so on. Among these indicators, the h-index provides a simple impact metric for individual authors that can readily be used in online searching, for example, with Google Scholar, but is also incorporated into the major citation databases such as the Web of Science and Scopus.

The international organizations like OECD and the National Governments have also followed the activity related to scientometrics. For example, the Organization of Economic Cooperation and Development (OECD) has published "Science, Technology and Industry Scoreboard" once every 2 years. In terms of an example of National Government activities, the National Science Board (NSB) in US also publishes "Science & Engineering Indicators" once every 2 years. In these publications, scientometrics indicators contribute to OECD and NSB efforts, especially in terms of standardization of calculations, collection of data, and analysis of a wide range of science, technology, and innovation activities by providing evidence on a selected set of Science and Technology (S&T) output.

Therefore, the concept of scientometrics has already disseminated to our society and has become essential for evidence-based policy makings, especially in the fields of S&T and Innovation.

2. Main points of this book

Technological change is one of the greatest issues in the modern world. As the world faces societal challenges, for example, climate challenges, aging problem, and energy security, technology will contribute to new or better solutions for those problems. New technologies take longer to develop and mature; moreover which tend to be born in the interconnection of multiple technology fields, therefore early detection of emerging technological concepts across multiple disciplines will be a very important issue.

Our goal is to seek to develop automated methods that aid the systematic, continuous and comprehensive assessment of technological emergence using one of the major foresight exercises, scientometrics. There is now a huge flood of scientific and technical information, especially scientific publications and patent information. Using the information patterns of emergence for technological concepts have been discovered and theories of technical emergence have also been developed in several years. We have been developing visualization tools that thousands of technical areas have been interacted with each other and evolved in time. Several indicators of technical emergence have been improved by universities, international organizations, and funding agencies.

This book intends to provide readers a comprehensive overview of the current state-of-the-art in scientometrics, focusing on the systematic, continuous and comprehensive assessment of technological emergence. This book is composed of 12 chapters by cutting-of-edge authors of many different nationalities from Europe to Asia.

Especially the chapter "Mapping Science based on research content similarity" by Dr Kawamura shows an interesting methodology for analyzing publications based on an adaptation of word embedding and paragraph embedding with an entropy-based word clustering methodology. The proposed combination of word embedding and entropy-based approach is very useful for the scientometrics community.

3. Conclusions and future perspective

Last but not least, we would like to mention an expected future landscape of this field. Now it is evolutionary time from basic research phase to implementation phase and scientometrics will be expected to be applied to the fields below at the implementation level.

3.1. IP landscape

Recently "IP landscape" has been referred in the field of intangible assets. IP landscape provides not only a snapshot but also a strategic analysis of the IP trends of a specific technology field within either a given company or a given country. It is said that the techniques or tools in scientometrics are very useful for the needs of IP landscape as following:

(i) understanding of IP for products and technologies,

(ii) building a simple model,

(iii) identification of key technology players,

(iv) discover of white areas where no one achieves a field yet, and

(v) understanding of stakeholders (e.g., competitors, upstream and downstream partners, potential acquisition target).

3.2. Data-driven innovation

Recently, creating a new business and solving social problems utilizing big data have been expected to increase. The Ministry of Economy, Trade and Industry in Japan is supporting business creation through data utilization, and enterprises are developing advanced measures in the fields such as agriculture and medical care. On the other hand, new cooperation beyond industrial barriers between a present entity and a new entity created sharing data is still limited. For the economic development in near future, so-called "Data-Driven Innovation" will be necessary for firms: for example firms will utilize data sharing beyond entities, creating new added value. Since companies, especially SMEs, have rarely data scientists who deal with big data, scientometrics indicator or tools thereof can contribute to enhancement of the data-driven innovation.

3.3. Fields close to scientometrics

Although "scientometrics" is mainly a study of relations between text of articles or patents and their authors/institutions, it is also highly corresponded to "science of sociology" which is mainly a study of relations between authors/institutions and text networking, or AI-related fields like "semantic search" and "machine translation." Interdisciplinary research with other fields is expected.

A reconstruction or remodeling of S&T fields above mentioned reinforces the knowledge-based development in terms of society and economy. Scientometrics will be able to foster a development of science, technology, and innovation by a quantitative perception and evidence-based policy making. Further study and development of scientometrics are expected in future.

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