



An Analysis on the Evolution Path and Hot Topics of Frugal Innovation—Visual Analysis Based on Citespace

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Abstract. Using CiteSpace software, 360 papers from CNKI in the field of frugal innovation are used to perform quantitative analysis and draw a visual map. The research shows that the number of published papers in this field is in good shape, which can be roughly divided into three stages; the research force is relatively scattered and the correlation between them is weak; research hotspot focuses on the construction of frugal innovation theory; the research trend reflects that the research in this field has changed from theory to practical application. Practice and application of frugal innovation will become the main direction of future research.

Keywords: frugal innovation · visualization · CiteSpace

1 Introduction

Innovation is an important factor that makes western developed countries take the lead in the world. With the increasing role of innovation, enhancing the ability of independent innovation is particularly important for being in a favorable position in international competition. However, after entering the 21st century, the center of world development began to shift to emerging economies [2]. The traditional innovation model of pursuing “high precision” relies on a large number of resources and time, but many emerging markets face problems such as resource constraints and institutional deficiencies [4], so the traditional innovation from developed countries will be unsuitable for developing countries. This transfer will cause inefficient innovation and unbalanced transformation of input and output [8]. In developing countries, there exists a large number of low and middle income groups, which are called BoP (Bottom of Pyramid) groups [3]. Frugal innovation originated in India and was centered on using fewer resources to deliver products and services to more people. In order to meet the needs of this huge market, the traditional innovation model needs to be changed to create more social value with less resources, money and time, and to produce more products and services that are high quality, inexpensive, resource and environment friendly, which is a disruptive growth strategy [13], thus frugal innovation comes in. The first focus of frugal innovation is to reduce unnecessary costs and unnecessary product designs, which are characterized by inexpensive, compact designs without excess structure, low cost, simple operation,

and the use of advanced high-end technology [16]. Under the COVID-19 pandemic, the slowdown of economic growth and economic restructuring will cause the income to decline and the low-income group to increase, so it is necessary to focus on the interests of low-income groups. Innovation should be combined with the economic situation, take more social responsibility and focus on improving people's livelihood. From the perspective of resource-saving and environment-friendly, the original crude development model and the innovation model with high energy consumption, high investment and high pollution should be abandoned. In this context, the inclusive, frugal, green and sustainable features contained in FI are of great practical significance to the development of the world economy.

Under the background of economic globalization and innovation-driven development, a large number of domestic researches on innovation paradigms have emerged, but there are few studies on the research context of innovation paradigms. After more than ten years of development, the scope and methods of frugal innovation have changed significantly [11]. Based on this, this paper uses relevant measurement methods and visualization tools through literature research to sort out the literature since frugal innovation was proposed, and analyze frugal innovation hot topics, evolution paths, and frontier issues of innovative. The research results are expected to provide some reference for the research and practical work in the field of innovation in my country, so as to further implement the innovation-driven development strategy and promote the construction of a scientific and technological power.

2 Research Methods and Data Sources

2.1 Research Methods

The scientific knowledge map can better display the development status of a specific field and its research hotspots, groups, frontiers and trends, and it has emerged and made great progress in literature research [7]. This paper uses the CiteSpace software developed by Professor Chaomei Chen to draw the scientific knowledge map of frugal innovation, in order to analyze the research hotspots and research trends of frugal innovation.

2.2 Data Sources

The time span of the research object is from 2013 to 2021, and the division is divided by one year, and the trend of frugal innovation is studied by analyzing the types of network nodes such as literature authors, institutions, and keywords. The literature data comes from CNKI, and the key word of literature search is "frugal innovation". After screening, conferences, newspapers, and books were excluded, and a total of 360 sample documents were finally included in the analysis.

3 Literature Feature Analysis

3.1 Quantitative Characteristics of Literature

In order to clearly understand the output of frugal innovation research, statistical sorting is carried out according to the release time of the sample literatures, and the quantitative

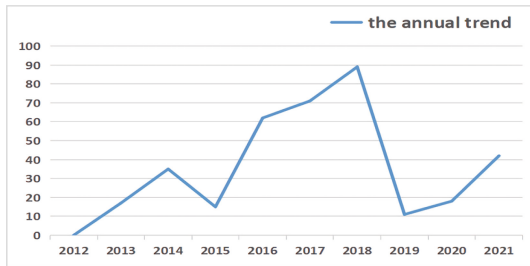


Fig. 1. The annual trend of changes in the number of sample documents



Fig. 2. Authors cooperation network

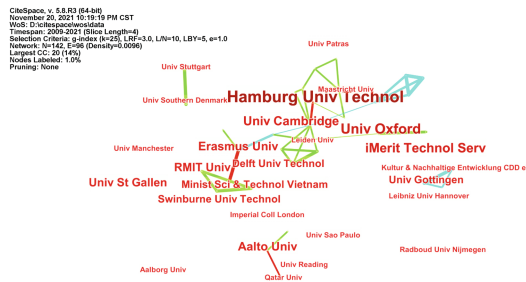


Fig. 3. Institutionals cooperation network

trend diagram of the literatures is drawn, as shown in Fig. 1. According to the annual distribution of literatures volume, the development process of frugal innovation can be roughly divided into three stages: 2012–2015 was the initial stage of research, and the number of papers with the theme of “frugal innovation” in this stage showed a slow increasing trend, declined in 2015. 2016–2018 is the rapid development stage of frugal innovation, and in 2018, it reached the peak of the number of publications. The third stage is from 2019 to 2021. In 2019, the number of published papers by frugal innovation subjects has dropped significantly compared with 2018, but the overall trend in this stage is an upward trend.

3.2 Author and Institutional Cooperation Network Analysis

From the author cooperation network diagram in Fig. 2, it can be seen that in the research process of frugal innovation, the distribution of authors is relatively scattered, and the degree of cooperation between them is small. The core authors of foreign literature in the field of frugal innovation are D Mourtzis, Hossain Mokter, Ana Labarta, Andrea Bencsik, etc. The domestic core authors mainly include Jin Chen, Lan Gospel, Yanhui Wei, Kun Wang, Jingjing Lin, etc. Authors at home and abroad cooperate with each other around these core authors and play an important role in the evolution of the frontiers of the field of frugal innovation. It can be seen from Fig. 3 and combined with the author's cooperation network that the distribution of institutions that study frugal innovation is relatively scattered, the cooperation between various institutions is less, and there is a lack of research centers for frugal innovation.

4 Analysis of Research Hotspots

Keywords are the core part of the literature and the best embodiment of research hotspots. Through the word frequency statistics of keyword co-occurrence, the hotspots of frugal innovation research can be grasped more scientifically. We use CiteSpace software to generate a knowledge map of frugal innovation research keywords co-occurrence (Fig. 4).

Clustering the node types with keywords as co-occurrence analysis to generate a keyword clustering map as shown in Fig. 5, these clusters show the key areas of domestic makerspace research in the past 8 years. It is divided into 9 clusters: 0# Reverse Innovation, 1# Bottom of the Pyramid, 2# Product Innovation, 3# Disruptive Innovation, 4# Emerging Economies, 5# Value Innovation, 6# Electric Vehicles, 7# Resource Constraints, 12# Hygiene Practice.

The first cluster is Reverse Innovation, which is the largest of all clusters, contains 56 keywords, and has an average year of 2016. The proposal of reverse innovation stems from the concern about the innovation and diffusion phenomenon of reverse promotion of products from emerging markets to developed markets. Its essential characteristics are: (1) originated and popularized in emerging markets to generate innovations driven by resource constraints (Zeskey, 2011); (2) reverse diffusion of innovations, and reverse diffusion of innovation benefits based on emerging markets to developed markets [5].

The second cluster, the Bottom of Pyramid, contains 22 keywords and the average year is 2015. Consumers at the bottom of the pyramid are the target group for frugal innovation, with a large population base, limited individual purchasing power, and long-term difficulties in enjoying innovation benefits [14]. Frugal innovation was originally created to provide these consumers with high-quality products and services at low prices and high quality, and improve the living standards of this consumer group.

The third cluster is Product Innovation, which contains 19 keywords and the average year is 2015. Product innovation is one of the main manifestations of frugal innovation. Simple products are the direct product of frugal innovation, and are also the interaction between frugal innovation and customers. Product features directly affect customers' perception of frugal innovation [9].

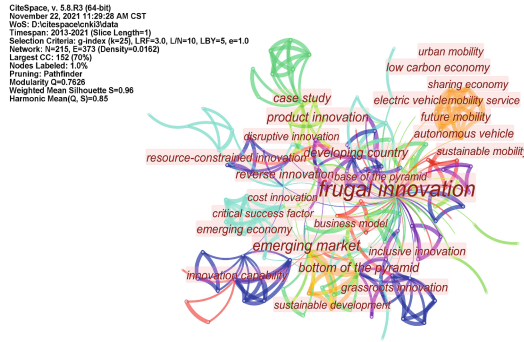


Fig. 4. Keywords co-occurrence map

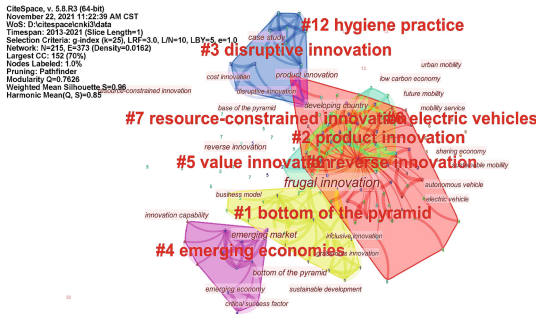


Fig. 5. Keywords clustering map

The fourth cluster, Disruptive Innovation, contains 14 keywords and the average year is 2016. Disruption is a description of the characteristics of frugal innovation [2]. Frugal innovation is a disruptive innovation that includes the redesign of products and their development processes to meet the needs of the broad base of the pyramid consumer group by providing products and services with the necessary characteristics.

The fifth cluster is Emerging Economies, containing 12 keywords, with an average year in 2015. Emerging economies are major birthplaces and hotbeds of frugal innovation. The characteristic conditions of emerging economies, such as the shortage of resources, funds, institutions, high-quality labor, technology and the environmental degradation, are the driving conditions for frugal innovation [15].

The sixth cluster is Value Innovation, which contains 9 keywords, and the average year is 2015. Frugal innovation includes not only products and services, but also processes, marketing methods and organizational methods to reduce production costs and finances from the perspective of developing, manufacturing, distributing, consuming and disposing of the entire value chain [17]. Frugal innovation sees and integrates the BoP customer base not only as potential customers, but also as producers and suppliers in the value chain.

The seventh cluster is Electric Vehicles, which contains 8 keywords, and the average year is in 2020. Electric vehicles are the result of frugal innovative products and

represent a class of products with frugal innovation characteristics [18]. The shortage of resources and the deterioration of the environment make the frugal innovation have the characteristics of green technology, sustainability and low carbon. Therefore, frugal innovative products can save a lot of resources, which is beneficial to environmental protection, which is of great significance to the sustainable development of society.

The eighth cluster is Resource Constraints, containing 8 keywords, with an average year in 2016. Resource constraints are characteristic of emerging economies and the driver of frugal innovation. Zeschky proposed that FI was born in a constrained scenario [19]. This constraint does not refer to resource constraints alone [1]. Hossain and Sarkar argued that factors such as markets, infrastructure, ecology, audience groups, and manufacturing levels are included [10]. Mainly manifested in the lack of key resources and the ineffective use of core resources, increasingly depleted resources and deteriorating ecological environment, the concept of sustainable development has been deeply rooted in the hearts of the people, and enterprises have to form a production model with less input and more output and less emissions, thus responding to the concept of sustainable development [12].

The ninth cluster is Hygiene Practice, containing 8 keywords, with an average year in 2016. The concept of frugal innovation mostly refers to the process and results of providing affordable products and services to low-income groups in emerging markets. Health practice is a relatively successful field of frugal innovation, which is embodied in the innovation of medical care equipment and medical care services [6].

5 Evolutionary Trend Analysis

From the development of the keyword clustering timeline in Fig. 6, it can be seen that the changes of the frugal innovation research hotspots are relatively gentle, and the clusters appear in chronological order. In the first stage, clusters No. 0, 1, and 2 were developed first, and the keywords contained in them appeared the earliest, on average in 2013.

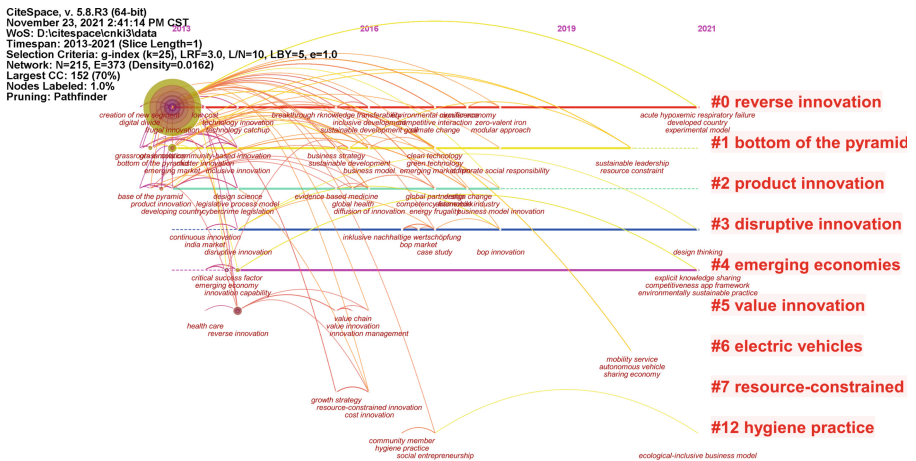


Fig. 6. Timeline development of keyword clustering

In the subsequent development, new keywords continued to appear and the interval was short, showing the research trends. In the second stage, clusters 3, 4, and 5 followed the first stage, and the keywords contained in them first appeared around 2014. In the third stage, clusters No. 6, 7, and 12 started late, and the keywords contained in them all appeared after 2016. The first two stages of clustering are basically based on the theoretical research of frugal innovation, while the new clusters No. 6 and 12 focus on the specific practice and application of frugal innovation, representing the main direction of future research.

6 Conclusions

This study selects 360 papers in the field of frugal innovation in CNKI, and uses the CiteSpace to conduct a visual analysis of the literature. It can be seen that in terms of the characteristics of the number of papers published, the number of papers related to frugal innovation fluctuates greatly, the peak period of the number of published articles was 2016–2018. The connection between scholars is not close, the distribution of institutions is relatively scattered, the cooperation between various institutions is less, and there is a lack of simple and innovative research centers. The research hotspots in frugal innovation are mainly concentrated in theoretical construction such as concept, motivation, and characteristics. In recent years, some scholars have begun to study the practical application of FI. Overall frugal innovation has gone through the process from concept definition to innovative application, which reflects the transformation from theory to practice in the field of frugal innovation, which will become the main direction of future research. We believe that future research directions can be combined with practice to study the process and mechanism of FI in enterprises from the micro level.

Acknowledgements. We are very grateful for the help provided by the following institutions and personnel: The Department of Education of Liaoning Province has provided us with sufficient scientific research funds to ensure the smooth progress of the project. Dalian Polytechnic University School of Management provided scientific research equipment to ensure the completion of this paper. Yaqi Cao provided valuable suggestions for revision of the pictures and format in the text. Chunhua Lv provided books and materials related to the application of the method, and I would like to express my thanks here.

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