Sustainable Business Model: A Bibliometric Study

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Abstract—Sustainability issues make the transformation to a more sustainable business model increasingly desirable. This study aims to analyze the literatures on SBM to provide a systematic review of the current status of the SBM literatures. This paper uses visual bibliometrics and comparative research methods to carry out collaboration, co-citation, and co-occurrence analyses of the literatures from the Web of Science by CiteSpace. Compared with the existing literature reviews of SBM, this paper makes a set of knowledge maps and analyzes visual results based on BMI-3 category framework to show the features of literatures, the future trend and the potential approaches contributing to SBM. It is the first study to present the major clusters to reveal their associated intellectual bases and research fronts in SBM.

1 INTRODUCTION

This Sustainable development is considered a major challenge of the 21st century. Sustainability problems, such as increasingly intensified inequality and the damage of the natural environment, constantly increase the demand for a more sustainable economic environment [1]. As the major source of value creation in the world, various organizations should bear most of the responsibility of obtaining a higher level of sustainability. In addition, for the purpose of realizing environmental and/or social sustainability, it is necessary to have more product innovations which are environmentally friendly and also to establish more transparent , sustainable supply chains and novel business models [2] [3]. In recent years, the attention paid to sustainable business model (SBM) in both academia and practical fields has rapidly increased. New findings come from various fields may radically change collective knowledge [4]. As SBM is evolving rapidly in both the industrial and academic fields, it is essential to keep the pace with the findings in related studies and to understand their highlights, fundamental knowledge, and so forth. In this study, we conducted correlation analysis, co-citation analysis and co-occurrence analysis of related literatures on sustainable business model by CiteSpace, and the high-frequency vocabularies are matched into the BMI-3 category framework. The knowledge structure, research development, some new problem and the future trend of SBM are proposed.

The organization of the paper is as follows. Section 2 covers the method, data collection process, and analytic software. Section 3 shows the results of citing papers (papers searched in this research) and cited papers (references for searched papers within this research). CiteSpace was adopted to carry out collaboration, cocitation, as well as co-occurrence analyses of the obtained data. Finally, Section 4 presents the discussion. Finally, Section 5 presents the significance and limitations of this research.

2 LITERATURE REVIEW

In recent years, the attention paid to sustainable business model (SBM) in both academia and practical fields has rapidly increased. At first, when this notion was conceived, its major intention was to push enterprises to promote the establishment of a more sustainable economic system, to assist enterprises in realizing their sustainability targets [5]. Afterwards, the concept of SBM has increasingly considered the important factor of competitive advantages [6][7], and a certain theoretical structure has already been established. Relevant studies show various subtypes, archetypes, or generic tactics of SBM [8][9]. The launch of the special issue on SBMs in clean production journal (Vol. 45, April 2013) and Organization and the Environment(Vol. 29, Is. 1, March 2016) shows the rapidly growing interest of academics and practitioners in this field. There is also a growing range of review articles emerging. N.M.P. Bocken reviewed relevant literatures and business practices and classified SBM using a systematic review method and proposed eight SBM archetypes to building up the business model for sustainability [8]. Rodrigo Lozano analyzed seven peer-reviewed papers widely cited in the field of SBM, and proposed a definition and framework for more sustainable business model. The article integrated stakeholders, company system, organizational approaches and sustainability dimensions to provide a more comprehensive and systematic approach to SBM [10]. Frank Boons reviewed the literatures on business model based on a three-category framework (technology, organization, social) and proposed replicable regulatory

requirements to enable sustainable and innovative business models to operate. Finally, the paper presented a number of guiding questions for future research [2]. In another article, Frank Boons also executed a comprehensive review on papers presented at the ERSCP-EMSU 2010 Conference held in Delft, The Netherlands. The paper provided a conceptual framework for researching the link between SBM, innovation, and competitiveness [11]. Antony Upward contributed to a framework of strongly SBM propositions and principles as through a transdisciplinary review of the literatures [12]. Martin Geissdoerfer provided a review of the literatures on SBM, using a systematic database search and cross-reference snowballing. After discussing some key concepts (business model, sustainable business model, business model innovation, and sustainable business model innovation), the paper identified a research gap: the implementation of BMI process, tools and challenges. Further, the paper deducted research questions to address the gap [9]. Stefan Schaltegger described the origins of sustainable business model, current research and future approaches [13].

Although a lot of literatures on SBM are available, the extant literatures have paid little attention to the holistic bibliometric analysis of SBMs. Conducting a holistic bibliometric analysis of a certain topic is conducive for researchers to have a better grasp of basic knowledge, the intellectual framework of a topic, and achieving progressive knowledge domain visualization [14]. As information technology progresses constantly, bibliometric analysis based on data mining tool can be applied to the formation of network images to provide more visual information, not just text [15], and make the literature review more comprehensive. And this is a research gap in existing SBM literature reviews. The objective of this paper is to explore the knowledge structure, development and the future trend of SBM combined with data mining based on CiteSpace and the BMI-3 category framework.

3 METHODS AND DATA COLLECTION

Based on the work of Zhao and Strotmann [16], this study adopted a four-procedure approach (definition of the search keywords, data scrubbing and formatting, primary analysis, and data analysis) to find out which studies are the most influential, to investigate study topics, and to offer insights for future studies in the related field.

In this study, the data used came from the Web of Science (WOS) in March 2020, including the following four databases contained within the Web of Science Core Collection: Social Sciences Citation Index, Science Citation Index Expanded, Conference Proceedings Citation Index-Social Science & Humanities, and Conference Proceedings Citation Index-Science. The Web of Science is a well-known literature database containing much information which can be used for research. For this reason, it was adopted here as the source of citations and was recommended by CiteSpace as well. In addition, the data within the Web of Science

has a larger time span in comparison with other databases and it is considered to be a better choice for CiteSpace analysis [17]. Consequently, the Web of Science can be used to better analyze the overall development of a certain research topic or area. In this research, "sustainab* AND business model*" were adopted as search keywords. The largest time span within the Web of Science is from 1900 to 2019. Nevertheless, 95% of the articles in this field were published between 2008 and 2019. As a consequence, 2008–2019 was determined to be the time span of this study, that is, the past 11 years. In addition, there was no limitation on language or document categories. The data downloading was carried out in March 2020 and was imported into CiteSpace V for further investigation. Prior to analysis, work needs to be done on data standardization. In addition to converting the data format to a CiteSpace-readable format, we also needed to eliminate duplicate data if the data were extracted from multiple databases of different architectures. In this study, data in a CiteSpace-readable format were exported directly from WOS, and the data used came only from WOS, which simplified the data cleaning and formatting work. In the final phase of the data collection procedure, 1868 records were retrieved for investigation.

4 ANALYSIS AND RESULTS

CiteSpace was adopted to carry out collaboration, cocitation, as well as co-occurrence analyses of the obtained data after the initial data statistics.

4.1 Initial data statistics

We retrieved and downloaded a whole set of records for 1868 publications in March 2020, which contained 10,018 references. We present the distribution of annual outputs in Figure 1. There was a rising trend in publications from 2008 to 2019, which changed from 32 to 372 publications. The stable rise in the number of publications in the past 11 years reveals both the significance of SBM research and the need to carry out data analysis and obtain quantitative & qualitative insights into this study area. Since the SBM is a subcategory of the business model with a relatively short history, in order to further obtain information on research trends of SBM, we also collected data from business model (BM) papers published during the same period for comparative analysis. As can be seen in Figure 1, from the comparison of annual publications of the two studies, the number of BM publications showed fluctuating growth, while the proportion of SBM publications in relation to that of BM showed significant and sustained growth. The proportion increased from 5% in 2004 to 22%in 2019. In particular, from 2004 to 2019, it is possible to distinguish three different phases. During the first phase from 2004 to 2008, the proportion was very low and grew slowly. In the second phase from 2008 to 2016, this proportion showed a significant linear increase. This is an important reason why the publication time range of the literature selected in this study was 2008–2019. With sustainable development gradually becoming

an important issue of human development, more and more attention has been paid to the sustainable business model. In the third phase from 2016 to the present, this proportion has shown a sharp increase, indicating SBM research has become a very important topic in BM research, and the "sustainability" has become a feature that cannot be ignored in the process of BM research.
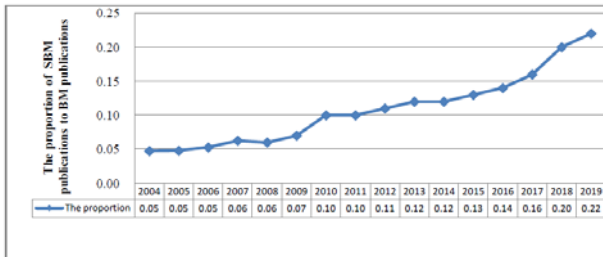

Figure 1. The comparison of annual publications of BM and SBM

We also list the Top 10 countries that produce the most papers in Table 2. The geographic distribution of the 1868 publications covered 57 countries/territories. Among the top 10 countries, the United States contributed the most and accounted for 15% of the total articles, followed by England with 261 records (14%). Germany, Italy, and the Netherlands ranked the third, fourth, and fifth, respectively. When we compared the regional distribution data of BM domain literature with the data of SBM domain, shown in Table 1 and Table 2, two interesting findings emerged: Of the top 10 countries in the two fields, nine overlap, with only two differences, and both countries are in the bottom three. This indicates that SBM is an important subset of BM research, and countries that attach great importance to BM research also attach great importance to SBM research in general. Another finding is that most of the top 10 countries rank and account for roughly the same amount of research in two areas, with two exceptions: China and the Netherlands. China ranks second in the number of publications in BM research field, accounting for 14%, while it ranks sixth in SBM, accounting for only 7%. In contrast, the Netherlands ranks seventh in BM research, with 4%, and fifth in SBM research, with 7%. The reasons behind this result may be that, as a developing country with rapid development, China has accelerated its economic construction and business model reform in the past four decades. Sustainable development is an issue that has received special attention only in recent years. A large number of researches based on China's sustainable development practices will become a research hotspot in the future. On the other hand, as the most densely populated country in Europe, the Netherlands has long attached great importance to sustainable development. Dutch enterprises have long regarded sustainable development as a core business concept. In terms of scientific research, the sustainable business model of the Netherlands has been fruitful. The practical experience of SBM in the Netherlands is worth learning from business practitioners. From the analysis of relevant research institutions, it was clear that Delft University of Technology in the Netherlands is the world's second

contributing institute for the study of sustainable business model.

TABLE 1. TOP 10 CONTRIBUTING COUNTRIES IN SBM

Country	Records	Proportion (%)
USA	261	14
ENGLAND	224	12
GERMANY	192	10
ITALY	175	9
PEOPLES R CHINA	160	7
NETHERLANDS	148	7
SWEDEN	113	6
SPAIN	86	4

TABLE 2. TOP 10 CONTRIBUTING COUNTRIES IN BM

Country	Records	Proportion (%)
USA	2086	16
PEOPLES R CHINA	1839	14
ENGLAND	1245	10
GERMANY	1234	10
ITALY	794	7
SPAIN	626	4
NETHERLANDS	551	4
SWEDEN	498	4

4.2 Collaboration analysis

The following part analyzes institutional collaborations from 2008 to 2019, and Figure 2 demonstrates the collaboration framework. Each node in Figure 2 represents a corresponding institution, and the linking lines between nodes show their collaboration. In addition, the collaboration degree is presented through the thickness of the lines. The institution distribution is highly concentrated, and the top 5 most productive institutions can be seen as the major institutions of certain collaboration. This shows that quite a few institutions have established stable partnerships and produced a large amount of SBM research. At the same time, we have also seen some new members with outstanding performance in this research field in recent years. Bucharest University in Romania has independently published 30 research papers on SBMs in the past three years, which also indicates that many countries and regions have felt great pressure and urgency to develop SBMs in recent years and started to engage in relevant researches.
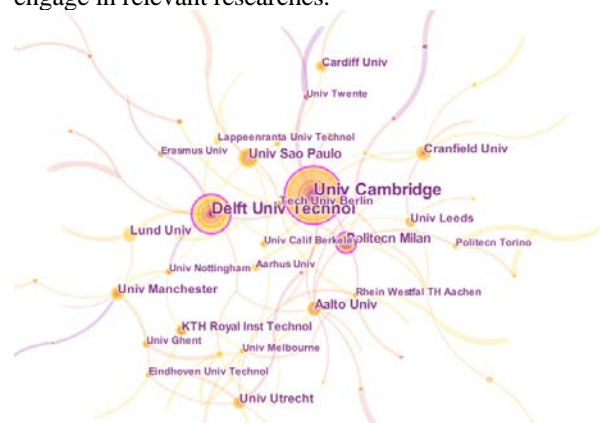

Figure 2. Map of institutions

Author collaborations from 2008 to 2019 are analyzed below. From the result showing the author map, it can be seen that there are two important nodes that identify influential authors in the SBM research field. One is Bock NMP from the University of Cambridge, Department of Engineering Institute for Manufacturing. She has published the most papers in the field of SBM, with 28 papers. Her focus is on the path and design of SBMs and sustainable innovation for business models. The other influential scholar is Steve Evans, also from the Institute for Manufacturing, University of Cambridge. He has published the second-largest number of papers related to SBM, with 19 papers. He focuses on value innovation and sustainable business model driven by technology in the industrial sector. In addition to the main research teams represented by them, we can also see several other active academic teams and individuals in the field of SBM. This study sorted the research groups and individuals active in the field of SBM in the past five years according to the number of published papers. Their representative articles and main research directions are shown in Table III.

TABLE 3. MAJOR RESEARCH TEAMS IN SBM

Leader Author	representative articles	Research direction
BOCKEN, NMP EVANS, S	1. A literature and practice review…[8] 2. The Circular Economy… [18]	Strategic research on sustainable business models
ZERRIFFI, H	Improved stoves in India… [19] Innovative business models …[20]	Innovative business models to scale up energy access.
LUDEKE-FREUND, F	Business Models for Sustainability…[21] Business Models for Sustainability: … [22]	Strategic research on sustainable business models and the sharing economy
PERBOLI G ROSANO, M	Synchro-Modality and Slow Steaming: …[23] Embracing the variety…[13]	Using industrial ecology to pursue the Sustainable Development; The sustainable development of transportation and logistics industry
GNONI, MG TORNESE, F	Hybrid simulation modeling…[24] Circular economy strategies … [25]	The design of Product-Service-System from circular economic model and sustainability.
HOVESKOG, M HALILA, F	Education for Sustainable Development… [26] Journey and impact of business model innovation… [27]	Processes and tools for business model innovation through case studies
VAN, LOOY, B	Servitization…. [28] Steering Manufacturing Firms Towards Service Business Model Innovation. [29]	Research on production service system
PIGOSSO, DCA	1.Guidelines for evaluating the environmental performance … [30] 2.Sustainable qualifying criteria…[31]	Design and study of sustainable qualification criteria.

4.3 Co-citation analysis

One significant part of bibliometric research is cocitation analysis [32]. Cocitation of references refers to when two references are cited by the same document. By analyzing the clustering and key nodes in the cocitation network, the knowledge structure of a certain research field can be revealed. CiteSpace can also express the knowledge basis of the research frontier in a unique way, the evolution of the research frontier, and the literatures that play a key role in the evolution process.

- Document Co-citation Network

A cocitation analysis of the literature was carried out, and a CiteSpace-based document cocitation network was formed. This can demonstrate which papers are the most impactful, and an intellectual base from which most publications were generated. A cocitation network was established by CiteSpace, which was constituted by dots standing for documents, referred to as nodes. Moreover, the linking of two nodes was achieved by a line under the situation where two documents were cited jointly in another article. CiteSpace was adopted for decomposing the network into clusters by using the "silhouette" measure, which quantified the degree to which nodes shown in a highly linked component were homogenous. After this, these clusters provided a chosen term which could be seen frequently in these documents. This task was finished by information retrieval and information mining, for instance, mutual information (MI), term-frequency–inverse document frequency (TF*IDF), and log-likelihood (LLR) [33]. Based on Chen [34], in comparison with the other two measures, labeling adopting LLR was more effective. There were altogether 723 nodes and 2069 edges in the document cocitation network. After grouping the network into several clusters, cluster analysis was performed. The clusters were labeled using the terms appearing in the indexing terms of the citing articles according to the LLR weighting algorithm. The silhouette value was used to depict the homogeneity of a cluster, and its range was from –1 to 1; the higher the value, the more meaningful the cluster. Table 5 provides a summary of cluster descriptors, including cluster IDs, scales, average years, sketches, as well as labels for the papers on SBM. The scale shows the number of papers included in a certain cluster.

Cluster(#0) is the largest cluster and has the label "designing productive-service systems", indicating the phrase was common in the papers included in this cluster. This cluster has 86 members and a silhouette value of 0.713. The first three publications, with the highest coverage in this cluster, are articles [35], [36], [37]. They all investigated business design and development based on the product-service system, and the publication dates range from 2006 to 2017. The second-largest cluster (#1) has 67 members and a silhouette value of 0.738. The cluster is labeled "Practice review". This cluster includes studies of transforming sustainable development into competitiveness based on practice review. Case studies and literature reviews are the main methods in this cluster. The top three articles, in order of citations, are [8] [38] [39]. The third-largest cluster (#2) with the tag "business incubation" has 63 members. The analysis framework

and theory of business model are the main topics in this cluster, and this cluster covers the longest time period, from 2000 to 2017. From this, we can see the SBM as a subset of the BM, so the framework and theory of the BM is also an important study tool for the SBM. Articles with the highest coverage are references [40] [41] [42]. The fourth-largest cluster (#3) contains 61 members and is labeled as "Sustainability-oriented innovation". This cluster includes articles discussing the development of business models from the perspective of sustainable innovation. The timeline view shows that the largest four clusters have still been active in recent years, while the fifth- and sixth-largest clusters with the tags "energy ecosystem" and "e-business", respectively, have faded in recent years. As can be seen, clusters (#6) and (#10), respectively labeled "circular economy" and "sharing economy", are the two most recently formed clusters, indicating that research on these subjects only started recently. The circular economy and sharing economy have spawned many new business models, and they describe and analyze the sustainability connotation of new business models. The newest clusters indicate that this is an active research area.

TABLE 4. THE COMMON CITATION CLUSTERS FOR SBM

Cluster ID	Scale	Silhouette	Mean (Year)	Label
#0	86	0.713	2011	Designing product-service system
#1	67	0.738	2012	Practice review
#2	63	0.663	2010	Business incubation
#3	61	0.829	2010	Sustainability-oriented innovation
#4	50	0.825	2011	Energy ecosystem
#5	28	0.918	2009	E-business sustainability
#6	26	0.945	2013	Circular economy
#7	25	0.954	2010	Off-grid PV
#8	22	0.943	2009	Supply chain
#9	21	0.91	2009	Renewable energy
#10	21	0.979	2014	Sharing economy
#11	17	0.995	2007	Ehealth technologies
#12	12	0.986	2008	Open service innovation

- Most cited articles and journals

The document co-citation network can also be used to find the most cited references. We collected 1868 papers on SBMs and their 10,018 citations and analyzed the most frequently cited papers in these 10,018 references. Based on the quotation frequency shown in Table 6, the top 10 most-cited papers were determined. One can see clearly that [43] was cited 191 times, thus ranking first. This shows that it is the most influential paper. It presents the business model canvas, which leads business thinkers'

concepts in the form of business model patterns, techniques to aid in designing business models, how business modeling is central to the discussion of strategy, and a generic process. It is a useful review of the literatures on business models and still presents topics for future exploration [44]. Article [8] was cited 184 times, ranking second. In this study, the archetypes of SBMs were explained to depict mechanism and solution groupings which may promote the establishment of SBMs. The archetypes from the article are listed below: maximize the efficiency of materials and energy; create value from waste; make use of recyclable materials and natural processes; offer functionality instead of ownership; establish a role of stewardship; promote sufficiency; repurpose the business for society/environment; and figure out how to scale-up countermeasures. Article [13] was cited 180 times, taking third place. This article reviewed the existing literature on business models in terms of technological, social, and organizational innovation and put forward examples of standard requirements to be met by business models for the purpose of promoting sustainable innovations. Article [45] is another impactful paper focusing on the SBM, which attempted to figure out the importance of business models and identify which links exist between them and business strategy, economic theory, and innovation management. Some initial standards for establishing a business model were provided and summarized in this paper. Article [46] was in fifth place in terms of its cocitation frequency. It identified common topics among researchers while studying business models. Specifically: (1) the business model shows up as a novel analysis unit; (2) business models lay emphasis on a systematic and comprehensive approach to make clear how enterprises engage in business; (3) enterprise activities are of significance in all kinds of conceptualizations of business models which have been put forward; and (4) business models aim to figure out the way in which value is created, instead of merely how it is obtained. Article [47] investigated the obstacles to business model innovation and revealed the course of experimentation and effectuation and how powerful leadership of organizational variation should play an important role for the purpose of dealing with these obstacles. Another work [48] was cited 79 times and was based on theoretical and empirical studies. It revealed two series of parameters to be taken into account by the designers of an activity system: design elements which depict the framework of an activity system, and governance and design themes which depict the sources of the value formation of a certain activity system. Papers [49][11] were in eighth and ninth place with 76 and 36 citations, respectively. The former put forward a structure for business model innovation as a way to tactically form business cases regularly, which are important components of business activities. The latter studied the correlations among sustainable innovation, strategy, and competitiveness as well as SBMs and emphasized the significance of SBMs for both the academic and practitioner fields to have certain achievements in sustainable innovation. Article [50] reviewed the related studies of product service systems (PSS) in the past 10 years and contrasted the findings with those from a

previous review in the Journal of Cleaner Production in 2006. It was shown that studies related to PSS have shown a rising trend, with a quadrupling of references papers, whereas the average amount of scientific output has only doubled, and that PSS has been integrated into various science and geographical areas. A main contribution of recent studies has been the investigation of the way in which enterprises have carried out PSS and the factors and problems to which close attention should be paid. Further, it identified the reasons for the failure of PSS to be implemented in a wide range.

All in all, four of the top 10 most frequently cited documents focused on the investigation of innovation in business models. These articles revealed that the study of sustainable development business models stems from the study of business model innovation and plays a positive role in the transformation of the BM to the SBM. Two of the top 10 documents addressed the following questions: Since the circular economy and the sharing economy have spawned new business models, how can these new business models be implemented considering sustainability, and what are their key success factors? These studies highlighted the circular business model as an important new trend in SBMs. The other six articles emphasized the design of BMs for innovation.

4.4 Co-occurrence analysis

- Analysis of keyword

In order to obtain more insights into the essence of the SBM field, keyword analysis was adopted, which helped to track the evolution of a particular research, figure out the hot topics and future trends of this research area [51]. Citation burst can show the most active study areas. Kleinberg's algorithm lays the foundation for CiteSpace's citation burst of keywords. It allows researchers to identify keywords that pop up and to adjust them according to the time they appear on various maps. A pool of 216 keywords was extracted from the 1868publications. Table 7 displays the top 20 strongest keyword bursts from 2008 to 2019. Table 7 can play a role for new researchers in carrying out studies on their topics of interest more logically and can guide other researchers to extend their analysis to other relevant fields. In recent years, many new sustainable business models have emerged regarding the circular economy and the sharing economy, such as the circular business model, the platform business model, and the platform ecosystem. These business models have been a research hotspot for SBMs in recent years and will also be in the future. To alleviate noise, this paper excluded some general and unrelated words, for example, "model". After this, words with identical meanings were integrated, for instance, ''supply chain'' and ''supply chain management''. In addition, of the top 20 keywords, we identified terms that have been cited in the past three years as patterns of growth: circular economy, sharing economy and sustainable consumption. These three topics are likely to be hotspots in the future.

In order to obtain more information on research frontiers, we used the same data collection and processing method (same database, time period, and analysis software) to obtain the emergent keywords in the BM field. We compared and analyzed the citation burst of keywords in the field of BM research with those in the field of SBM. From these two tables, we can easily see that the keywords are very similar. There are many words related to organizational strategy, value creation, and research methods that appear in both tables, such as business model canvas, value proposition, and case study. In addition, a large number of technical terms with high strength appear in both tables, and there are significant differences in the specific technical terms that appear in these tables. The result shows many technical terms with characteristics of the times, such as e-business, cloud computing, big data, digital technology, and electric vehicle, indicating that business models develop and innovate along with technological innovations and revolutions. The technical terms in SBM are more focused and emerging than those in BM. This shows that the sustainable development business model is the innovation of the traditional business model driven by emerging technology.

- Analysis of the factors from abstracts

Co-occurrence term analysis goes deeper into the text than keyword analysis and reflects more comprehensive information. To clarify the factors and theories adopted in previous studies, this paper screened terms (noun phrases) from the abstracts of all collected articles to show the elements based on their appearance frequency. The key terms were selected by CiteSpace and be divided into independent variables and dependent variables listed in Table 8. The independent variable is considered to be the factor that causes the change of the dependent variable. After filtering, the 25 key terms were retained as independent variables and 12 key terms as dependent variables, the result is shown in Table V

TABLE 5. THE KEY TERMS IN ABSTRACTS

Independent variable		Dependent variable	Theory & Method
communication technology	cleaner production	value creation	case Study
cloud manufacturing	Eco-design	sustainable growth	lifecycle assessment
technological innovation	recycling	decision-making process	holistic approach
green technology	closed loop	value capture	triple bottom line
supply chain	industrial symbiosis	sustainability transition	circular economy principles
regulatory framework	PSS	service innovation	hierarchical cluster analysis
key stakeholders	social enterprise solutions	customer satisfaction	systematic approach,
corporate social responsibility	prosperity without growth	sustainable manufacturing	institutional theory

social value	ethical sourcing	social innovation	content analysis
social entrepreneurs	demand management	capacity building	practice review
big data	frugal business models	consumption pattern	morphological analysis
environmental concern	take-back management	business process	hierarchical cluster analysis
iot			

The independent variable was matched into the three dimensions of the frame (BMI 3-category). The framework of BMI 3-category was proposed by Boons and Lüdeke-Freund, which proved more effective in understanding the underlying mechanisms within the business model innovations. Using this framework to classify these key entries can more clearly sort out the features and gap of existing literatures. The three dimensions in the BMI-3 category framework are technology, organization and social. The technology aspect involves the technologies that can be combined with business models to facilitate business model innovation. The organization aspect involves the variations at the level of organizations can change the business model of an enterprise and drive it toward sustainable development. Sustainable development is a collection of these different organizational levels. The social aspect involves the factors at social level, which positively influence SBMs exist including product and process innovation with social intentions and another is correlated with the range of entrepreneurial and managerial activities. The BMI 3-catergory frame presents a conceptual framework and reveals some missing information. At the same time it has the important enlightenment significance to the future research direction. (1) We help scholars expand their research by sorting independent variables into three dimensions of business model innovation; (2) Social aspects should be the focus of the SBM domain, they are factors driving the sustainable business model, but they are not enough in the existing research; (3) Most of the theories of SBM come from the BM field, and the existing research methods mostly adopt case study and empirical analysis, but lack of research based on data-driven and analytical perspective, future research should explore more theoretical models on the basis of BM theory to enrich the understanding of SBM; (4) The framework was used to develop a list of potential approaches that contribute to business model innovation for sustainability.
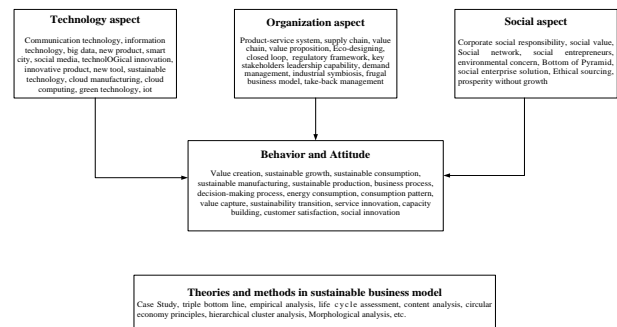

Figure 3. Sustainable business model transformation framework

5 DISCUSSION

This paper presents a bibliometric analysis of the global research on sustainable business model in the period from 2008 to 2019. The collaboration analysis, co-citation analysis and co-occurrence analysis were performed to assess the number of publications, active research institutions, countries and authors, and the knowledge base.

In order to understand the research trend of SBM in the timeline, we use the strength of citation bursts and timeline view to analyze keywords. Key information was extracted from the abstract and matched with the BMI-3 framework, providing important ideas for the practice and theoretical research direction of SBM. Some findings are as follows:

- The stable rise in the number of publications of SBM in the past 11 years, through comparative analysis, this paper has shown that sustainability is an increasingly important feature of business model research. The development of energy technology such as renewable energy, off-grid PV promotes the transformation of business model to sustainable development. The arrival of a new economy driven by technology brings more possible forms of sustainable business model. Circular business model, sharing business model and platform business model not only brought new industries but also brought business innovation in traditional industries.

- The geographic distribution of the 1868 publications covers 57 countries/territories. Comparing the number of publications in the two fields of SBM and BM, researchers and institutions in the Netherlands have paid special attention to the SBM. While a large number of researches based on China's sustainable development practices will become a research hotspot in the future.

- Four major clusters of SBM research have been uncovered in this study. The papers in these clusters are similar to the knowledge base of subdomains, and the intellectual base can be labeled as the cluster tags. For example, Table 9 shows that the latest cluster has 26 papers as its intellectual base. This cluster is concerned with the circular economy perspective for the purpose of business model innovation for sustainability.

The papers which cite elements of this cluster can be viewed as current research fronts. Take an example, the paper [76]'s work can be seen as the current research frontier which based on the intellectual base of the taxonomy of Circular Economy Business Models.

• The comparative analysis of keywords with strongest citation bursts in the two fields (SBM & BM) shows that technology drives the innovation of BM, and technology is a major precursor to sustainable business models

• The co-occurrence of important terms extracted from abstracts was analyzed using BMI-3 framework.

• a. We help scholars expand their research by sorting independent variables into three dimensions of business model innovation; b. Social aspects should be the focus of the SBM domain, they are factors driving the sustainable business model, but they are not enough in the existing research. Moreover, most of them are emerging in recent years; c. Most of the theories of SBM come from the BM field, and the existing research methods mostly adopt case study and empirical analysis, but lack of research based on data-driven and analytical perspective, future research should explore more theoretical models on the basis of BM theory to enrich the understanding of SBM; d. The framework was used to develop a list of potential approaches that contribute to business model innovation for sustainability.

6 CONCLUSION

6.1 Suggestions for Research

Based on visual correlation, co-citation and concurrency analyses, this paper provided important framework to classify SBMs activities and theories. New technologies can trigger new business models to sustainable development direction ; Sustainable business model is an expression of organizational and cultural changes in business practices, which integrates the desire and drive for sustainable development [5] [98][99]; Social innovation is seen as the key to creating and transforming business models towards sustainable development [100][101]. Different approaches such as "bottom of the pyramid" strategies or social businesses emerging models for environmental sustainability is recently emerging concept of social entrepreneurship in the research of SBM. In the evolution of business model to the sustainable direction of innovation, how to combine and balance the three aspects is a further research topic. From the practice review, new search terms such as"ethical sourcing", "industrial symbiosis", "demand management", "eco-design" and "cleaner production" amongst others. Furthermore, there are also two emerging research directions: Sustainable business model in circular economy and sharing economy. "take-back management",

"closed-loop models", "value cocreation", and "frugal business models" are the emerging search terms in this field. The new economy requires companies to rethink and design business models in a radical way. Hence, future work includes that identifying the methods and tools for circular business model and sharing platform model; proposing dynamic tool to support the configuration of new business models[102].

6.2 Methodological Contributions

This article adopted CiteSpace as a visualized analytical technique to analyze the limitations of current research and future research direction. Compared with the existing literature review of SBM, this paper made a set of knowledge maps and carried out a comparative analysis between BM and SBM to show the future trends of SBM. This paper analyzed visual results based on BMI-3 category framework to show the potential approaches to SBM and limitations of current research. To the best of our knowledge, it is the first study to put forward the major clusters to reveal their associated intellectual bases and research fronts in SBM. The result of research enriched bibliometric analysis method and extended types of literature review. Utilizing this tool may play a guiding role for researchers in carrying out knowledge mapping with the proper analytic components of existing papers.

6.3 Practical Contributions

This paper has divided the key terms into BMI-3 category framework. This classification of influencing factors can guide companies to develop sustainable business models through technological, organizational, and social strategy. This is the basis for business model innovation tools, which can be individually or combined into a combined toolkit. Our important recommendation to business practice is that enterprises need to aware of the complexity and risks of sustainable business model transformation, and the demand to develop new business models through experimentation. In addition, we can help enterprises better understand the current business model and identify new business models that are more suitable for the future through the research direction.

6.4 Limitations and Future Research

Even though this paper has gained some insights after the bibliometric analysis and visualization of publications relevant to SBMs, this research still has certain insufficiencies. The documents were downloaded from SCI-EXPANDED, SSCI, CPCI-S and CPCI-SSH databases through the Web of Science, and over 99% of the works were in English. Because of this, there may be an underestimation of studies done in different languages. Due to the growing quantity and quality of SBM studies, future literature mining can take into account more databases. The analysis techniques can be enriched as well to obtain more useful information.

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