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China Association for Science and Technology
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Blue Book on China's Scientific Journal Development (2022)

Platform for Academic Publishing and Exchange in the Era of Digital Economy

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Blue Book on China's Scientific Journal Development (2022) has the theme of "Platform for Academic Publishing and Exchange in the Era of Digital Economy". Relying on renowned domestic and foreign databases and official data, we use scientific measurement methods, analyze existing problems, summarize the law of development, sort out and analyze the overall situation of Chinese science and technology journals and scientific papers, present the whole status of Chinese science and technology journals in the form of data. Besides, we study the changes in global digital publishing technology, discuss the domestic and foreign digital resources and academic exchange platform progress and trends, explore Chinese academic publishing fusion and high-end academic exchange platform development path and put forward suggestions about Chinese academic publishing and exchange platform development in the digital economy era.

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Expert Committee

Blue Book on China's Scientific Journal Development 2022

Development & Compilation Committee

Blue Book on China's Scientific Journal Development 2022

Compilation Working Group

Blue Book on China's Scientific Journal Development 2022

Group leader: Bin PENG

Deputy group leader: Peiyi LIU

Group members: (in alphabetical order by last name)

Shenyi HUANG, Jingjing LIU, Rong LIU, Xiaomin LIU, Na MA, Ran MI, Lingshu QIAN, Shengli REN, Xiukun SUN, Hong TIAN, Zhi WANG, Yanqin WENG, Junhong WU, Yinjie WU, Xian XIAO, Yue XIAO, Wanzhen XU, Qiwen YANG, Yingzhi ZHOU

Translators
Lu WANG, Liping GU, Xin LI, Buqing NA, Boya SHEN, Jiayue YU, Yi ZHANG

Reviewer
Mark Garlinghouse

Secretariat
Rong LIU, Ran MI, Liying LIU, Tianyi ZHU

Preface

According to the National 14th Five-Year Plan for Digital Economy Development, "the rapid development of the digital economy, its wide range and unprecedented impact are driving profound changes in the mode of production, lifestyle and governance, and becoming a key force in restructuring global factor resources, reshaping the global economic structure, and changing the global competition landscape." The digital economy is highly innovative, with strong penetration and wide coverage. It is the fulcrum of the transformation of traditional industries and can become an important engine to promote the transformation and upgrading of industry.

In recent years, with the rapid development of the new generation of information technology represented by big data, cloud computing and artificial intelligence, the digital economy and the real economy have been deeply integrated, and have become the fastest developing, the most innovative and the most important field. According to the "China Digital Economy Development Report (2022)" released by China Academy of Information and Communication, in 2021, the scale of China's digital economy reached 45.5 trillion yuan, accounting for 39.8% of GDP; the scale of digital industrialization in China is 8.4 trillion yuan, accounting for 7.3% of GDP; the development of digital industrialization is undergoing a historic transformation from quantitative expansion to qualitative improvement; the scale of digital industry is 37.2 trillion yuan, accounting for 32.5% of GDP, and the industrial digital transformation continues to accelerate in depth.

Science and technology journals directly reflect the extent of national science and technology competitiveness and cultural soft power. As an important part of China's science and technology and cultural undertakings, science and technology journals play an important role in leading the development of science and technology, promoting scientific and technological innovation, popularizing scientific knowledge, and spreading science and culture. Facing the development trend of the global digital economy and the advantages of China's digital economy, it is the development trend of academic publishing in the era of digital economy to promote the digital communication and service capacity construction of science and technology journals and to build an intelligent academic ecosystem.

Science and technology journals have massive scientific research data and rich application scenarios. Through digital technology, they can produce enabling, connectivity and fusion effects, drive the growth of the digital economy, and further develop digital

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productivity. Therefore, science and technology journals and digital technology depth fusion have innate development advantages. Through digital technology, the digital economy can enable technology journals' transformation and upgrading, accelerate the digitization, specialization and intensification process, open up the industrial chain, restructure the value chain, from the innovation chain, create more new forms and modes, bring unlimited opportunities for science and technology journals to realize the innovation leap in the major development inflection point, and promote Chinese science and technology journals to become stronger, better and bigger.

With the rapid progress of science and technology, the competition between the global economy, science and technology is becoming increasingly fierce, and the urgency and importance of "running first-class academic journals and various academic platforms" are becoming more and more prominent. Digital technology is subverting the academic publishing mode, and the digital economy is reconstructing the business logic of the development of science and technology journals. The quality and security of scientific data, the construction of academic platforms and so on will usher in new opportunities and challenges in the development wave. China's academic publishing industry should build on the situation, strive to open up new fields and new tracks for development, and constantly shape new drivers and advantages of development.

After many discussions by experts from the expert committee and the writing committee, it was determined that the Blue Book on the Development of Chinese Science and Technology Journals (2022) shall focus on "the topic of academic publishing and exchange platform in the era of digital economy", which resonates with China's development of science and technology, economy and social development. Under the background of the digital economy, we use research methods such as literature review, scientific measurement, comparative research, and expert interview, study global digital publishing technology change, discuss the domestic and foreign digital resources and academic exchange platform progress and trend, explore Chinese academic publishing fusion and high-end academic exchange platform development path and put forward suggestions about Chinese academic publishing and exchange platform development in the digital economy era.

The Blue Book on the Development of Chinese Science and Technology Journals records as well as facilitates the development of the Chinese science and technology journal industry. It is committed to planning and promoting the construction of Chinese science and technology journals from a broader and more long-term perspective and contributing the wisdom of the science and technology journal industry to achieve self-reliance and build a powerful country in science and technology, with a higher political position and a stronger mission responsibility.

With the strong support of many experts and scholars from the expert committee and the writing committee, the writing team of this book adheres to the principles of fairness and objectivity, collects data from facts, screens cases, searches documents, analyzes problems, summarizes rules, extracts the huge data and references, and strives to present the development status of Chinese science and technology journals and papers in a comprehensive manner. It also attempts to describe the progress of the domestic and foreign academic publishing and exchange platforms in the era of digital economy and the mission and contribution of Chinese science and technology journals. Here, we would like to express sincere thanks to all the experts, scholars and industry colleagues who have worked hard for the preparation and publication of this book!

The Science Press undertook the editing and publication of this book and completed the publication work on schedule to a high standard. Here, we would like to express sincere thanks to all the institutions that provide data and publishing services!

Due to the limited ability of the editor, some inadequacies and omissions are inevitable, and we look forward to the majority of readers' comments, criticisms and corrections.

China Association for Science and Technology
November 2022

Contents

Chapter 1

General Information of China's STM Journals

Peiyi LIU, Yingzhi ZHOU, Zhi WANG and Rong LIU

Abstract

Current Situation of China's STM Journals

General Features of China's STM Journals

Based on the data from the *National Journal Annual Inspection Report 2021* by the National Press & Publication Administration (NPPA), there were a total of 5071 Science, Technology, and Medical journals (STM journals hereafter) published in China at the end of 2021. The report notes the general features of the journals are: (A) The numbers of STM journals published in different regions vastly vary. Regions ranked top five in terms of publication volume and published more than half of the total journals (2712 journals, 53.48%). The top five regions are: Beijing (1671 journals, 32.95%), Shanghai (357 journals, 7.04%), Jiangsu (258 journals, 5.09%), Hubei (214 journals, 4.22%) and Sichuan (212 journals, 4.18%). (B) In terms of publication cycle, bi-monthly journals (1970 journals, 38.85%) and monthly journals (1823 journals, 35.95%) are the majority, accounting for 3/4 of the total volume. (C) In terms of language, Chinese language journals take up the major part (4482 journals, 88.38%), and the number of English language journals is 420 (8.28% of the total). There are 169 Chinese-English journals (3.33% of the total). (D) In terms of discipline, there are 1570 journals (30.96%) in basic science, 2271 journals (47.78%) in technology & science, and 1152 journals (22.72%) in medicine & health. (E) The overall pricing of China's STM journals is relatively low, especially Chinese language journals. The average price of China's STM journals is under RMB 50 yuan per issue.

Distribution of Managing, Hosting and Publishing Organizations

The industry is characterized by a large group of small publishers with a single journal title and a small group of larger publishers with more than 10 journal titles. According to the

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Report, the managing, hosting and publishing[1] organizations of the 5071 STM journals in China were somewhat scattered. (A) There were 1325 managing organizations, each managing 3.83 journals on average. Among them, 871 managing organizations only manage one journal each (accounting for 65.74%). There were only 74 managing organizations (5.58%) that manage over 10 journals each. (B) Based on the statistics of the first hosting organizations, there were 3153 hosting organizations, each hosting 1.61 journals on average. There were 2429 hosting organizations that hosted only one journal each (accounting for 77.04%). (C) There were 4354 publishing organizations, each publishing 1.17 journals on average. 4171 organizations only published one journal each (which means organizations publishing only one journal accounting for 95.80%). 3421 (78.57%) publishing organizations were editorial offices with only one journal, while only 10 publishing organizations published over 10 journals each.

STM Journal Personnel

China's STM journal industry had total personnel of 36 806 persons. There is a relatively large number of the editorial staff and a relatively small number of "publishing" staff (doing work related to journal title management, branding, marketing, sales, etc.). In terms of employment type, the majority was permanent staff, accounting for 64.30%; in terms of job type, the majority was editorial staff (59.50%); and in terms of academic background, staff with a bachelor's degree or a master's degree were the majority (75.24%). In terms of professional titles, staff with intermediate titles accounted for 28.00%, staff with vice-senior titles accounted for 22.09%, and staff with senior titles accounted for 19.65%.

STM Journal Publishing Operation

In terms of funding support, a small number of STM journals received funding from their managing organizations, and nearly half of STM journals received funding from their hosting organizations, with most of these organizations providing support of less than 300 000 yuan per year. Only 4.67% of STM journals received national-level special funds, and the support for individual journals fell in the range of 400 000 yuan to 500 000 yuan. The percentage of STM journals that received support from industry special funds was 1.46% with the support per journal not exceeding 300 000 yuan. The share of STM journals receiving support from local special funds was 2.48% with the support per journal below 100 000 yuan.

In terms of STM journal operations, 58.92% of STM journals had a circulation of less than 1500 copies. 51.54% of STM journals were distributed *via* "postal distribution & self-distribution", and 56.92% of STM journals had annual distribution revenue of less than 100 000 yuan. There were two-thirds (66.42%) of STM journals carried out advertising activities, and 59.54% of STM journals had an annual advertising revenue of less than 300 000 yuan. Nearly two-thirds (65.60%) of STM journals had an annual copyright revenue of less than 50 000 yuan; 98.00% of STM journals had no income from overseas

[1]According to the "Regulations for Administration of Periodical Publication" issued by China's National Press and Publication Administration in 2005, periodicals shall be published by publishing units established in accordance with laws.... To establish periodicals or periodical publishing units, the requirement of possessing an administration or sponsor which is recognized by the National Press and Publication Administration should be met.

publications. Only 12.13% of STM journals had income from project activities, and 53.21% of STM journals had an annual income of less than 400 000 yuan from activities. In terms of total revenue, 54.50% of journals had an annual revenue of less than 700 000 yuan, while 33.30% had an annual revenue of 1 million yuan and above. In terms of total expenditure, 52.11% of journals had an annual expenditure of less than 700 000 yuan, while 33.08% had an annual total expenditure of 1 million yuan or more.

1.1 Analysis of Current Situation of China's STM Journals

The analysis in this book is based on the data from the 2021 National Journal Annual Inspection (2021 Annual Inspection hereafter). The data were sorted according to the Chinese Library Classification (CLC) Code of China's publications, with the standardized serial CN number. Relevant data on China's STM journals were taken (5037 items, including popular science journals), with consideration to the information of newly approved journals by the state, title-changed journals during 2018–2021, and revoked journals during 2017–2021. Comparison was made with the data in China's STM Journal Directory in the *Blue Book on China's Scientific Journal Development* published during 2017–2021. The statistical results showed that the total number of China's STM journals was 5071 by the end of 2021.[2]

1.1.1 Basic Facts of Journals

1.1.1.1 Regional Distribution of Publications

The numbers of STM journals published in different regions are unevenly distributed. The 5071 STM journals in China were distributed regionally as follows: Beijing as No. 1 (1671 journals, 32.95% of all journals); Shanghai (357 journals, 7.04%), Jiangsu (258 journals, 5.09%), Hubei (214 journals, 4.22%), and Sichuan (212 journals, 4.18%). Five regions published over 200 STM journals each; 11 provinces, regions and cities published 100–200 STM journals each; and 10 provinces, regions and cities published 50–100 journals each. To sum up, in terms of distribution by place of publication, five regions published over 200 STM journals each; 16 regions published over 100 STM journals each; and 26 regions published over 50 STM journals each. For the detailed distribution of journal numbers, please refer to table 1.1.

1.1.1.2 Distribution by Publication Cycle

In terms of publication cycle, most of China's STM journals are monthly and bi-monthly journals. Statistics of the 5071 STM journals show that (tables 1.1 and 1.2), the top three types of journals, sorted by publication cycle and ranked by the number of journals, were: bi-monthly (1970 journals, 38.85%), monthly (1823 journals, 35.95%), and quarterly (757 journals, 14.93%). Among them, bi-monthly journals and monthly journals together accounted for 74.80% of all journals (3793 journals). Beijing had the largest number of

[2]The statistics of China's STM journals in this book do not include data on journals that did not participate in the 2021 annual inspection, nor the data on journals in Hong Kong, Macao and Taiwan regions.

Tab. 1.1 – Distribution of China's STM journals in 2021 (by region) (Unit: no. of journals).

Serial no.	Region	Yearly	Semi-yearly	Quarterly	Bi-monthly	Monthly	Semi-monthly	Ten-day	Weekly	Bi-weekly	Total
1	Beijing	29	4	197	488	767	141	35	7	3	1671
2	Shanghai	1	2	55	167	121	8	3	0	0	357
3	Jiangsu	1	0	46	132	66	8	3	2	0	258
4	Hubei	3	1	22	95	74	14	5	0	0	214
5	Sichuan	0	0	43	89	70	5	4	1	0	212
6	Guangdong	1	1	22	74	66	20	4	0	0	188
7	Liaoning	1	0	15	90	66	6	3	0	0	181
8	Heilongjiang	1	0	26	65	57	8	4	2	0	163
9	Shaanxi	0	1	21	74	53	9	2	1	0	161
10	Tianjin	2	1	15	60	53	5	4	0	0	140
11	Hunan	0	0	23	59	41	6	2	1	0	132
12	Shandong	0	0	28	58	38	6	2	0	0	132
13	Zhejiang	0	0	31	52	37	4	1	0	0	125
14	Henan	2	1	19	46	36	8	5	2	0	119
15	Hebei	0	0	16	40	34	11	7	1	0	109
16	Jilin	0	0	18	39	29	9	7	1	0	103
17	Anhui	1	0	14	46	27	5	1	0	0	94
18	Shanxi	0	0	14	36	25	10	4	0	0	89
19	Chongqing	0	0	6	27	28	13	3	2	0	79
20	Fujian	0	3	19	35	18	0	0	0	0	75
21	Guangxi	1	0	16	25	27	3	0	3	0	75
22	Jiangxi	0	0	14	32	16	8	1	0	0	71
23	Gansu	0	0	8	43	12	4	0	0	0	67
24	Xinjiang	1	5	22	24	6	0	0	0	0	58
25	Yunnan	0	0	7	23	15	3	4	0	0	52
26	Inner Mongolia	0	2	6	21	17	2	1	2	0	51
27	Guizhou	0	0	7	18	10	1	0	0	0	36
28	Qinghai	0	0	13	5	1	0	0	0	0	19
29	Hainan	0	0	4	0	5	3	1	0	0	13

TAB. 1.1 – (continued)

30	Ningxia	0	0	3	1	7	0	0	0	0	11
31	Tibet	0	1	5	3	0	0	0	0	0	9
32	Xinjiang Production & Construction Corps	0	1	2	3	1	0	0	0	0	7
	Total	44	23	757	1970	1823	320	106	25	3	5071

Note: Ranked by the number of published journals.

Based on the statistics of reporting units in the national journal annual inspection, Xinjiang Production and Construction Corps was counted separately.

Tab. 1.2 – Distribution of China's 5071 STM journals in 2021 (by publication cycle) (Unit: no. of journals).

Frequency	No. of journals	% of total	Frequency	No. of journal	% of total
Bi-monthly	1970	38.85	Yearly	44	0.87
Monthly	1823	35.95	Weekly	25	0.49
Quarterly	757	14.93	Semi-yearly	23	0.45
Semi-monthly	320	6.31	Semi-weekly	3	0.06
Ten-day	106	2.09	Total	5071	100.00

monthly journals (767 journals), accounting for 42.07% of all monthly journals in China. When compared in terms of publication cycle, 5 regions—Beijing, Chongqing, Guangxi, Hainan, and Ningxia—had the highest percentage of monthly journals; Qinghai and Tibet had the highest percentage of quarterly journals, and other provinces, regions and cities all had bi-monthly journals as the major journal type.

1.1.1.3 Distribution by Language and Discipline

Chinese language journals account for the majority of China's STM journals. Among the 5071 STM journals, there were 4482 Chinese language journals (88.38%, among which 4436 journals were in Mandarin, 20 in Uyghur, nine in Mongolian, seven in Kazak, five in Tibetan language, two in Korean language, two in Sino-Tibetan language, one in Sino-Myanmar language), 420 English language journals (8.28%), and 169 Chinese-English journals (3.33%) (table 1.3).

Mandarin STM journals were mostly in "industrial technology general introduction" (1715 journals, 38.66%), "medicine, health and comprehensive medicine & health" (995 journals, 22.43%), "agriculture, forestry, and comprehensive agricultural science" (487 journals, 10.98%), "natural science general introduction" (416 journals, 9.38%). Ethnic minority languages STM journals were mostly in "agriculture, forestry, and comprehensive agricultural science" (15 journals, 32.61%), "medicine, health, and comprehensive medicine & health" (13 journals, 28.26%), and "natural science general introduction" (11 journals, 23.91%). English language STM journals were mostly in "industrial technology general introduction" (118 journals, 28.09%), "medicine, health, comprehensive medicine & health" (92 journals, 21.90%), and "mathematical & physical science and chemistry" (65 journals, 15.48%) (table 1.3).

Based on the distribution by the discipline of the 5071 STM journals in China, there were 1570 journals in "basic science" (30.69%), including 466 journals in "natural science general introduction", 211 journals in "mathematical & physical science and chemistry", 248 journals in "astronomy and geosciences", 109 journals in "biological science", and 536 journals in "agriculture, forestry and comprehensive agricultural science"; 2271 journals in "technical science" (44.78%), including 1876 journals in "industrial technology general introduction", 225 journals in "transportation", 76 journals in "aeronautics and spaceship", 94 journals in "environmental science and safety science"; 1152 journals in "medicine & health" (22.72%) (table 1.3); 78 journals in "comprehensive science" (1.54%).

Tab. 1.3 – Distribution of China's 5071 STM journals in 2021 (by language and discipline) (Unit: no. of journals).

Category	Discipline	Mandarin	English	Chinese-English	Ethnic minority language	Total
Basic Science (1570)	N Natural Science General Intro	416	23	16	11	466
	O Mathematical & Physical Science and Chemistry	134	65	12	0	211
	P Astronomy, Geosciences	197	40	11	0	248
	Q Biological Science	66	36	7	0	109
	S Agriculture, Forestry, Comprehensive Agricultural Science	487	21	13	15	536
Technical Science (2271)	T Industrial Technology General Intro	1715	118	41	2	1876
	U Transportation	208	8	9	0	225
	V Aeronautics, Spaceship	67	6	3	0	76
	X Environmental Science, Safety Science	77	11	4	2	94
Medicine & Health (1152)	R Medicine, Health, Comprehensive Medicine & Health	995	92	52	13	1152
Comprehensive Science (78)	Z Comprehensive Science	74	0	1	3	78
	Total	4436	420	169	46	5071

Note: "Ethnic minority language" mainly refers to Uyghur, Mongolian, Kazak, Tibetan, Korean, Sino-Tibetan and Sino-Myanmar.

1.1.1.4 Distribution by Pricing

The pricing of China's STM journals is relatively low, mostly below RMB 50 yuan per issue, especially Chinese language journals. Among the 5071 STM journals in China, 4988 journals provided data on pricing. The average pricing for the 4988 journals was 31.41 yuan per issue, the median pricing being 20 yuan per issue, the lowest pricing was 1.6 yuan per issue (only 1 journal), and the highest was 1000 yuan per issue (1 journal, *China Chemical Industry Yearbook*). There were 159 effective prices. 1936 journals priced at 10–20 yuan per issue as the dominant (accounting for 38.81%). 1120 journals (22.45%) priced at 20–30 yuan (table 1.4). The average price of Mandarin STM journals was 25.43 yuan per issue, the median price was 16.90 yuan. The pricing of ethnic minority languages STM journals was lower, with an average of 8.23 yuan per issue, and a median of

Tab. 1.4 – Pricing distribution of China's STM journals in 2021.

Price/yuan	No. of journals	% of total	Price/yuan	No. of journals	% of total
<10	546	10.95	80 ~	74	1.48
10 ~	1936	38.81	90 ~	21	0.42
20 ~	1120	22.45	100 ~	125	2.71
30 ~	484	9.70	150 ~	41	0.82
40 ~	191	3.83	200 ~	62	1.24
50 ~	197	3.95	300 ~	35	0.70
60 ~	117	2.35	500 ~ 1000	9	0.18
70 ~	20	0.40	Total	4988	100.00

Note: In the 2021 journal annual inspection data, 4988 journals provided pricing information; 83 journals did not provide pricing information.

seven yuan per issue. The pricing of English STM language journals was higher, with an average of 105.78 yuan per issue, and a median of 80 yuan per issue.

1.1.1.5 Distribution by Managing, Hosting and Publishing Organizations

The managing, hosting and publishing organizations of China's STM journals are scattered, with most publishing organizations being the editorial offices of a single journal. According to statistics, the 5071 STM journals in China had 1325 managing organizations in total, which means each organization managed 3.83 journals on average. 871 organizations (65.74% of all managing organizations) only managed one journal each; 204 organizations (15.40%) managed two journals each; and 176 organizations (13.28%) managed three-nine journals each. 74 organizations (5.58%) managed over 10 journals each. The top 10 managing organizations of STM journals, ranked by the number of journals, were: the China Association for Science and Technology (CAST) (482 journals), the Ministry of Education (454 journals), the Chinese Academy of Sciences (CAS) (297 journals), National Health Commission (216 journals), Ministry of Agriculture and Rural Affairs (92 journals), Ministry of Industry and Information Technology (68 journals), China Machinery Industry Federation (66 journals), Jiangsu Education Department (53 journals), China National Light Industry Council (46 journals) and China Electronics Technology Group Corporation (40 journals).

Based on the statistics on the first hosting organization,[3] the 5071 STM journals in China had 3153 hosting organizations, each organization hosting 1.61 journals on average. 2429 organizations (77.04% of all hosting organizations) hosted only one journal each, 402 organizations (12.75%) hosted two journals each, and 286 organizations (9.07%) hosted 3–9 journals. 36 organizations (1.14%) hosted 10 (and above) journals each. There were 16 hosting organizations ranked top 10, based on the number of journals hosted: Chinese Medical Association (CMA) (148 journals), Chinese Preventive Medicine Association (CPMA) (34 journals), Chinese Medical Doctor Association (CMDA) (27 journals),

[3]According to the "Regulations for Administration of Periodical Publication" issued by China's National Press and Publication Administration in 2005, for two or more units to establish a periodical together, a major sponsor (*i.e.*, the first organization) must be chosen for making the application.

Zhejiang University (25 journals), Chinese Academy of Sciences (CAS) (20 journals, only including journals that had CAS as the hosting organization, not including those hosted by subordinate institutions of CAS), Tsinghua University (20 journals), Beijing Prominion Publishing Co. Ltd. (19 journals), Higher Education Press Limited Company (18 journals), Chinese Academy of Medical Sciences (CAMS) (18 journals), Sichuan University (17 journals), Xi'an Jiaotong University (17 Journals), Central South University (17 journals), Machinery Industry Information Research Institute (17 journals), Chinese Mechanical Engineering Society (17 journals), China Science Publishing & Media Ltd (17 journals) and China Association of Chinese Medicine (17 journals).

The 5071 STM journals in China were published by 4354 organizations, with each organization publishing 1.17 journals on average. 4171 organizations (95.80% of all publishing organizations) published only 1 journal each. 3421 publishing organizations were the editorial office of a single journal, accounting for 78.57% of the total. The top 10 publishing organizations, ranked by the number of journals published, were: China Science Publishing & Media Ltd. (Science Press, 145 journals), Chinese Medical Association Publishing House Co. Ltd. (143 journals), Beijing Promonion Publishing Co. Ltd. (20 journals), Higher Education Press Limited Company (20 journals), Tsinghua University Publishing House Co. Ltd. (20 journals), Zhejiang University Publishing House Co. Ltd. (18 journals), Science China Press Co. Ltd. (17 journals), China Railway Publishing Housing Co. Ltd. (13 journals), Boyuan Publishing Co., Ltd., Central Iron and Steel Research Institute (12 journals), and China InfoCom Media Group Co. Ltd. (10 journals).

1.1.2 Journal-Running Conditions and Human Resources

1.1.2.1 Journal Operation Location

China's STM journals have stable locations for operations. Among the 5037 STM journals that participated in the 2021 journal annual inspection, excluding invalid data, 5006 journals filled in the data on operation area and property rights, including journals that owned over two types of operation locations. There were 3775 journals (75.41% of all journals) which had operation locations provided by their higher-level authorities and the operation areas were mostly between 25 and 75 m^2 (not including 75 m^2). 601 journals (12.01%) owned their operation locations, and the operation areas were mostly between 25 and 75 m^2 (not including 75 m^2). 735 journals (14.68%) rented their office for operations, and the operation areas were mostly between 25 and 75 m^2 (not including 75 m^2) (table 1.5).

1.1.2.2 Human Resources

1.1.2.2.1 Analysis of China's STM Journal Personnel

Among the 5037 STM journals that participated in the 2021 annual journal inspection, 4978 journals filled in personnel information. Statistics (table 1.6) show that in total there were 36 806 persons working for China's STM journals. 2212 journals had 4–6 staff members per journal, accounting for 44.44% of all the journals; 957 journals (19.42%) had 10 (and above) staff members; and 60 journals (1.21%) had 30 and above staff members.

Tab. 1.5 – Operation area of China's STM journals 2021.

Operation area/m^2	Location provided by higher-level authority		Self-owned location		Rented location		Total	
	No. of journal	% of total	No. of journal	% of total	No. of journal	% of total	No. of journals	% of total
<25	347	9.19	81	13.48	48	6.53	476	9.31
25 ~	1105	29.27	119	19.80	132	17.96	1356	26.53
50 ~	919	24.34	114	18.97	124	16.87	1157	22.64
75 ~	429	11.36	67	11.15	67	9.12	563	11.02
100 ~	490	12.98	89	14.81	103	14.01	682	13.34
125 ~	77	2.04	14	2.33	33	4.49	124	2.43
150 ~	142	3.76	25	4.16	67	9.12	234	4.58
200 ~	151	4.00	36	5.99	88	11.97	275	5.38
300 ~	82	2.17	17	2.83	43	5.85	142	2.78
500 ~	33	0.87	39	6.49	30	4.08	102	2.00
Total	3775	100.00	601	100.00	735	100.00	5111	100.00

Note: Among the 5037 data provided for the 2021 annual inspection, 74 were invalid, hence there were 5006 valid data, including journals that owned more than 2 types of operation locations. Journals had an operation area below 25 m^2, excluding data reported as "0".

1.1.2.2.2 China's STM Journal Personnel Analysis: Permanent and Non-Permanent Staff

The majority of China's STM journal personnel are permanent staff. According to the 2021 annual inspection data, there were 23 665 (64.30%) permanent staff and 13 141 non-permanent (35.70%) staff working for China's STM journals. The statistics (table 1.7) show that 10 regions each had STM personnel of over 1000 people, with Beijing having the most—12 591 people (34.21% of the total personnel). Among the 32 provinces, regions, and cities, plus Xinjiang production and construction corps, 27 regions had a permanent staff of over 60%, with the highest percentage being 91.90%. Guangxi and Hainan had permanent staff below 50%, with the lowest being 45.61%. 2039 journals had all staff members as permanent, accounting for 40.96% of all journals. 314 journals (6.31%) had all staff members as non-permanent.

1.1.2.2.3 Analysis of Personnel Composition of China's STM Journals

The majority of China's STM journal personnel are acquisition editors. According to the annual inspection data, STM journal personnel consist of acquisition editors, new media, administrative, advertisement, distribution, and other staff. Based on statistics (table 1.8) editorial staff normally were responsible for the topic selection, paper acquisition and processing, accounting for 59.50% of all STM journal personnel. Administrative staff were responsible for the daily management of the editorial offices, accounting for 11.86%. Distribution staff were responsible for marketing and promotions, accounting for 7.93%. New media staff (6.43%) were responsible for academic content promotions and advertising staff (5.88%) were responsible for advertisement operations. These two types accounted for

Tab. 1.6 – Distribution of China's STM journal personnel in 2021 (by publication cycle) (Unit: no. of journals).

No. of staff per journal	Publication cycle									Total
	Yearly	Semi-yearly	Quarterly	Bi-monthly	Monthly	Semi-monthly	Ten-day	Weekly	Semi-weekly	
1 ∼	5	7	181	291	109	5	2	1	0	601
4 ∼	20	11	402	1085	641	42	10	1	0	2212
7 ∼	8	3	87	425	585	80	16	4	0	1208
10 ∼	5	1	32	102	258	77	26	4	0	505
13 ∼	3	1	7	20	88	37	13	5	0	174
16 ∼	0	0	4	6	49	26	10	0	0	95
19 ∼	1	0	1	8	20	18	7	1	0	56
22 ∼	1	0	2	7	32	13	10	2	0	67
30 ∼	0	0	1	4	8	12	10	2	0	37
40 ∼	0	0	1	1	8	4	0	0	0	14
50 ∼	0	0	0	0	0	0	0	3	0	3
70 ∼	0	0	0	2	1	0	1	1	1	6
Total	43	23	718	1951	1799	314	105	24	1	4978

Note: Among the 5037 data items provided for the 2021 annual inspection, there were 59 blank items, hence there were 4978 valid data in total.

TAB. 1.7 – Personnel analysis of China's STM journals in different regions 2021.

Region	Total personnel	Permanent staff		Non-permanent staff	
		Permanent staff	% of total	Non-permanent staff	% of total
Beijing	12 591	6802	54.02	5789	45.98
Shanghai	2513	1761	70.08	752	29.92
Jiangsu	1701	1284	75.49	417	24.51
Guangdong	1543	824	53.40	719	46.60
Hubei	1463	974	66.58	489	33.42
Sichuan	1367	974	71.25	393	28.75
Shaanxi	1215	838	68.97	377	31.03
Liaoning	1142	899	78.72	243	21.28
Heilongjiang	1083	829	76.55	254	23.45
Henan	1044	776	74.33	268	25.67
Tianjin	935	816	87.27	119	12.73
Hunan	886	560	63.21	326	36.79
Chongqing	880	524	59.55	356	40.45
Shandong	869	686	78.94	183	21.06
Hebei	840	526	62.62	314	37.38
Shanxi	805	566	70.31	239	29.69
Zhejiang	753	528	70.12	225	29.88
Guangxi	752	343	45.61	409	54.39
Anhui	748	452	60.43	296	39.57
Jilin	679	492	72.46	187	27.54
Jiangxi	493	350	70.99	143	29.01
Fujian	460	348	75.65	112	24.35
Inner Mongolia	421	302	71.73	119	28.27
Gansu	418	308	73.68	110	26.32
Yunnan	372	255	68.55	117	31.45
Xinjiang	247	227	91.90	20	8.10
Guizhou	213	153	71.83	60	28.17
Hainan	124	57	45.97	67	54.03
Qinghai	93	81	87.10	12	12.90
Ningxia	61	46	75.41	15	24.59
Tibet	56	49	87.50	7	12.50
Xinjiang Production & Construction Corps	39	35	89.74	4	10.26
Total	36 806	23 665	64.30	13 141	35.70

Note: Among the 5037 data items collected in 2021, 59 items were blank, hence there were 4978 valid data left.

Tab. 1.8 – Personnel composition of China's STM journals in 2021.

Personnel composition	Mandarin journal		English journal		Chi-Eng journal		Ethnic minority language journal*		Total	
	Persons	%	Persons	%	Persons	%	Persons	%	Persons	%
Editorial	19 689	59.06	1336	65.17	715	60.59	158	65.56	21 898	59.50
New media	2033	6.40	149	7.27	73	6.19	12	4.98	2367	6.43
Administrative	4010	12.03	302	9.85	131	11.10	24	9.96	4367	11.86
Advertisement	2055	6.16	43	2.10	59	5.00	7	2.90	2164	5.88
Distribution	2699	8.10	127	6.20	78	6.61	13	5.39	2917	7.93
Others	2749	8.25	193	9.41	124	10.51	27	11.20	3093	8.40
Total	33 335	100.00	2050	100.00	1180	100.00	241	100.00	36 806	100.00

Note: Among the 5037 data items provided for the 2021 annual inspection, 59 items were blank, hence there were 4978 valid data left.
*Ethnic minority language journals refer to journals in Uyghur, Mongolian, Kazak, Tibetan, Korean, Sino-Tibetan, and Sino-Myanmar.

the lowest portion of the total personnel. There were 2–5 editorial staff per journal on average (3601 STM journals, accounting for 72.34%).

1.1.2.2.4 Academic Background Analysis of China's STM Journal Personnel

The majority of China's Chinese language STM journal personnel have an undergraduate degree. The majority of English language STM journal personnel have master's degrees. Based on statistics (table 1.9), most of China's STM journal personnel have bachelor's and master's degrees, with a total number of 27 693 persons, accounting for 75.24% of all personnel. Mandarin journals had the largest number of personnel with 33 335 persons, accounting for 90.57% of all staff. Many Mandarin journal personnel had bachelor's degrees, with a total of 15 341 persons, accounting for 46.02%. English language journals had a personnel of 2050 persons, the majority of which have master's degrees, with a number of 893 persons, accounting for 43.56%.

1.1.2.2.5 Analysis of Professional Titles of China's STM Journal Personnel

Among the 5037 journals that participated in the 2021 annual inspection, 4978 journals provided information on the personnel's professional titles. The statistics (table 1.10) show that 25 699 people (69.74% of all personnel) had intermediate titles and above, among which 15 364 people (41.74%) had senior titles.

1.1.3 Publication Management and Content Review

Among the 5037 STM journals that participated in the 2021 annual inspection, 4910 journals provided information on publication management and content review. The statistics show that apart from new media content inspection, there have been solid implementation effects of the management and review of China's STM journals (table 1.11).

a. Guidance and management from managing and/or hosting organizations. 4999 STM journals (99.25%) indicated that they received regular guidance and management from their managing and/or hosting organizations.

b. Policy of "Review for three times plus proofreading for three times". 5004 STM journals (99.34%) indicated that they implemented this policy (31 journals didn't provide this data).

c. Regulations for publishing organizations on registration of major topic selections. 4991 STM journals (99.09%) implemented such regulations (31 journals didn't provide this data).

d. Regulations for academic journals on avoiding academic misconduct and protecting academic ethics. Except for 325 non-academic journals, 4200 STM journals filled in this item; 512 journals didn't provide this data. 4183 STM journals implemented such regulations, accounting for 88.77%.

e. Regulations on new media content review. 3391 journals implemented regulations on new media content review, accounting for 67.32%; 37 journals didn't implement such regulations (including journals without new media content). The new media projects of 1609 journals were under construction, and data for this item had not been filed.

f. Regulations on separating editorial operations from business operations. 4903 journals (97.34%) indicated that their editorial operations and business operations

Tab. 1.9 – Academic background of China's STM journal personnel in 2021.

Academic background	Mandarin journal		English journal		Chi-Eng journal		Ethnic minority language journal*		Total	
	Person	%	Person	%	Person	%	Person	%	Person	%
Ph.D.	4293	12.88	757	36.93	279	23.64	15	6.22	5344	14.52
Master's	10 125	30.37	893	43.56	398	33.73	47	19.50	11 463	31.14
Bachelor's	15 341	46.02	325	15.85	398	31.73	166	68.88	16 230	44.10
College degree and under	3576	10.73	75	3.66	105	8.90	13	5.39	3769	10.24
Total	33 335	100.00	2050	100.00	1180	100.00	241	100.00	36 806	100.00

Note: Among the 5037 data items provided for the 2021 annual inspection, 59 items were blank, hence there were 4978 valid data left.
*Ethnic minority language journals refer to journals in Uyghur, Mongolian, Kazak, Tibetan, Korean, Sino-Tibetan, and Sino-Myanmar.

Tab. 1.10 – Professional titles of China's STM journal personnel in 2021.

Professional title	No. of personnel	% of total personnel
Senior	7233	19.65
Associate senior	8131	22.09
Intermediate	10 305	28.00
Junior and under	11 137	30.26
Total	36 806	100.00

Note: Among the 5037 data items provided for the 2021 annual inspection, 59 items were blank, hence there were 4978 valid data left.

Tab. 1.11 – Facts of China's STM journal management regulations in 2021.

Management regulations	Yes		No		Not clear	
	No. of journals	%	No. of journals	%	No. of journals	%
Regular guidance and management from managing/hosting organizations	4999	99.25	7	0.14	31	0.62
Implementation: "Thrice reviews plus thrice proofreading"	5004	99.34	2	0.04	31	0.62
Implementation: regulations on registration of major topic selection	4991	99.09	15	0.30	31	0.62
Implementation: regulations on avoiding academic misconduct and protecting academic ethics*	4183	88.77	17	0.34	512	10.16
Implementation: new media content review	3391	67.32	37	0.73	1609	31.94
Implementation: editorial separated from business operations	4903	97.34	103	2.06	31	0.62

Note: *The statistics didn't include the data of 325 non-academic journals.

were separate; 103 journals didn't separate their editorial and business operations; and 31 journals didn't provide this data.

1.1.4 Funding of China's STM Journals

1.1.4.1 Funding from Managing and Hosting Organizations

A small number of STM journals receive funding support from the managing organizations, while almost half of STM journals in China receive funding support from the hosting organizations. Most of the support from managing and holding organizations is within 300 000 yuan per year.

Among the 5037 STM journals that participated in the 2021 annual inspection, 5006 journals reported data on funding support from managing and hosting organizations.

Tab. 1.12 – Funding from managing and hosting organizations in 2021.

Funding/in thousand yuan	From managing organizations		From hosting organizations	
	No. of journals	%	No. of journals	%
<50	48	9.36	164	7.06
50 ~	71	13.84	280	12.05
100 ~	94	18.32	344	14.80
150 ~	33	6.43	219	9.42
200 ~	59	11.50	255	10.97
250 ~	13	2.53	102	4.39
300 ~	35	6.82	180	7.75
350 ~	19	3.70	58	2.50
400 ~	29	5.65	112	4.82
450 ~	13	2.53	44	1.89
500 ~	30	5.85	182	7.83
600 ~	24	4.68	130	5.59
800 ~	12	2.34	76	3.27
1000 ~	15	2.92	140	6.02
2000 ~	14	2.73	37	1.59
10 000 ~	4	0.78	1	0.04
Total	513	100.00	2324	100.00

Note: Among 5037 data items of the 2021 annual inspection, 4493 journals did not receive funding from their managing organizations (or support was "0"), and 31 journals didn't provide this data. 2682 journals did not receive funding from their hosting organizations (or support was "0"), and 31 journals didn't provide this data.
Due to rounding, the aggregated data in the tables may not match the actual calculated data in the main text. The same applies to the following.

According to the statistics (table 1.12), 513 journals received funding support from their managing organizations, accounting for 10.25%; 4493 journals did not receive funding support from managing organizations, accounting for 89.75%. 2324 journals received funding support from their hosting organizations, accounting for 46.42%; 2682 journals did not receive funding support from hosting organizations, accounting for 53.58%. The funding support from managing organizations was concentrated around 300 000 yuan (318 journals, accounting for 61.99%, excluding journals reported 0 support); similarly, the funding support from hosting organizations was concentrated around 300 000 yuan (1364 journals, accounting for 58.69%, excluding journals reported 0 support). There were 99 journals that received funding support of 500 000 yuan or more from their managing organizations, accounting for 19.30%; there were 566 journals that received funding support of 500 000 yuan or more from their hosting organizations, accounting for 24.35%.

1.1.4.2 National-Level Special Project Funds

Among the 5037 STM journals that participated in the 2021 annual inspection, 5006 journals filled in the data on national-level special project funds. 234 journals received national-level special project funds, accounting for 4.67%. According to the statistics

Tab. 1.13 – National-level special project funds in 2021.

Special project funds/in thousand yuan	No. of journals	%	Special project funds/in thousand yuan	No. of journals	%
<100	11	4.70	500 ~	16	6.84
100 ~	7	2.99	1000 ~	38	16.24
200 ~	8	3.42	2000 ~	13	5.56
300 ~	4	1.71	10 000 ~	3	1.28
400 ~	134	57.26	Total	234	100.00

Note: Among the 5037 data items of the 2021 annual inspection, 4772 journals did not receive national-level special project funds (or the support level "0"), and 31 journals didn't provide this data.

(table 1.13), the funding support from national-level special projects was mainly concentrated in the range of 400 000 yuan to 500 000 yuan. 134 journals received national-level funds, accounting for 57.26%. There were 54 journals that received funding support of 1 million yuan or more, accounting for 23.08%.

1.1.4.3 Publishing Industry Special Project Funds

Among the 5037 STM journals that participated in the 2021 annual inspection, 5006 journals filled in the data on publishing industry special project funds, of which 73 journals received funds, accounting for 1.46%. The statistics show (table 1.14) that the funding support from publishing industry special project funds was mainly below 300 000 yuan (not including), accounting for 50.68%; 12 journals received publishing industry special project funds of 500 000 yuan or more, accounting for 16.44%.

Tab. 1.14 – Publishing industry special project funds in 2021.

Special project funds/in thousand yuan	No. of journals	%	Special project funds/in thousand yuan	No. of journals	%
<50	13	17.81	300 ~	3	4.11
50 ~	11	15.07	400 ~	21	28.77
100 ~	6	8.22	500 ~	12	16.44
150 ~	2	2.74	Total	73	100.00
200 ~	5	6.85			

Note: Among the 5037 data items of annual inspection, 4933 journals did not receive publishing industry special project funds (or the support was "0"), and 31 journals didn't provide this data.

1.1.4.4 Provincial and Municipal Special Funds

Among the 5037 STM journals that participated in the 2021 annual inspection, 5004 journals filled in the data on provincial, regional, and municipal special funds, of which 124

journals received support from these funds, accounting for 2.48%. The statistics (table 1.15) show that most of the funding support from these special funds was below 100 000 yuan, accounting for 48.39%; 17 journals received support from these special funds of 500 000 yuan or more, accounting for 13.71%.

Tab. 1.15 – Provincial and municipal special funds in 2021.

Special project funds/in thousand yuan	No. of journals	%	Special project funds/in thousand yuan	No. of journals	%
<50	18	14.52	300 ~	10	8.06
50 ~	42	33.87	400 ~	10	8.06
100 ~	12	9.68	500 ~	5	4.03
150 ~	6	4.84	1000 ~	12	9.68
200 ~	7	5.65	Total	124	100.00
250 ~	2	1.61			

Note: Among the 5037 data items of the 2021 annual inspection, 4880 journals did not receive provincial and municipal special funds (or the support was "0"), and 33 journals didn't provide this data.

1.1.4.5 Funds from Other Organizations

Among[4] the 5037 STM journals that participated in the 2021 annual inspection, 5006 journals provided data on other special funds, of which 128 journals received support from these funds, accounting for 2.56%. The statistics (table 1.16) show that most of the funding

Tab. 1.16 – Funds from other organizations in 2021.

Special project funds/in thousand yuan	No. of journals	%	Special project funds/in thousand yuan	No. of journals	%
<50	30	23.44	250 ~	1	0.78
50 ~	24	18.75	300 ~	17	13.28
100 ~	22	17.19	500 ~	12	9.38
150 ~	11	8.59	Total	128	100.00
200 ~	11	8.59			

Note: Among the 5037 data items of the 2021 annual inspection, 4878 journals did not receive funds from other organizations (or the support was "0"), and 31 journals didn't provide this data.

[4] "Other special funds" refer to special funds from other than those organizations mentioned above, such as "funds from the managing or holding organizations", "national-level special funds", "publishing industry special project funds", and "provincial and municipal special funds".

support from other special funds was below 100 000 yuan, accounting for 42.19%; 12 journals that received 500 000 yuan or more from other special funds, accounting for 9.38%.

1.1.5 Business Condition of China's STM Journals[5]

1.1.5.1 Print Run

1.1.5.1.1 Average Print Run

Among the 5037 STM journals participating in the 2021 annual inspection, 4908 journals provided data on "average print run". After excluding 32 invalid data entries with a print run of "0", there were 4876 journals with valid data. The statistics (table 1.17) show that journals with an average print run below 1000 copies accounted for 27.63% (1347 journals); those with an average print number between 1000 and 1500 copies accounted for 25.78% (1257 journals); and those with an average print number of 10 000 copies and above accounted for 4.96% (242 journals).

Tab. 1.17 – Average print run in 2021.

Average print run/copy	No. of journals	%	Average print run/copy	No. of journals	%
<500	392	8.04	5000 ~	348	7.14
500 ~	955	19.59	10 000 ~	119	2.44
1000 ~	1257	25.78	20 000 ~	84	1.72
1500 ~	446	9.15	50 000 ~	23	0.47
2000 ~	655	13.43	100 000 ~	16	0.33
3000 ~	581	11.92	Total	4876	100.00

Note: Among 5037 data items of the 2021 annual inspection, 129 journals which didn't provide this data and 32 journals which filled in data with a print run of "0" (OA journals) were excluded in the statistical range.

1.1.5.1.2 Average Circulation

More than half of China's STM journals have an average circulation of less than 1500 copies. Among the 5037 STM journals participating in the 2021 annual inspection, 4908 journals filled in the data on "average circulation". After excluding 76 invalid data entries with a value of "0", there were 4832 journals with valid data. The statistics (table 1.18) show that journals with an average circulation below 500 copies accounted for 15.79% (763 journals); those with an average circulation between 500 and 1000 copies accounted for 23.99% (1159 journals); and those with an average circulation of 10 000 copies and above accounted for 4.47% (216 journals).

[5]The data related to the income of the journal publishing industry are not uniform, and the operation data of the journals in this book is based on the data of the 2021 annual inspection of NAPP, which is limited to the differences in the understanding of the data fillers, and the data on the income and expenditure of the journals may be incomplete, and the results of the statistics are for reference only.

Tab. 1.18 – Average circulation in 2021.

Average circulation/copy	No. of journals	%	Average circulation/copy	No. of journals	%
<500	763	15.79	5000 ~	300	6.21
500 ~	1159	23.99	10 000 ~	100	2.07
1000 ~	925	19.14	20 000 ~	79	1.63
1500 ~	418	8.65	50 000 ~	22	0.46
2000 ~	565	11.69	100 000 ~	15	0.31
3000 ~	486	10.06	Total	4832	100.00

Note: Among the 5037 data provided for the 2021 annual inspection, 129 journals which didn't provide this data and 76 journals which filled in data with "0" were excluded in the statistical range.

1.1.5.2 Distribution Methods and Revenue

Among the 5037 STM journals participating in the 2021 annual inspection, 4996 journals filled in the data on "distribution methods." The statistics show that 3521 journals (70.48%) used postal distribution (combined with other distribution methods), 3965 journals (79.36%) used self-distribution (combined with other distribution methods), 2575 journals (51.54%) used "postal distribution & self-distribution", and 88 journals (1.76%) used OA and distributing complimentary copies.

Among the 5006 STM journals that filled in "distribution revenue" data in the 2021 annual inspection, 1078 journals (21.53%) reported "0". The statistics (table 1.19) show that 1632 journals had annual distribution revenue below 50 000 yuan (not including), accounting for 41.55%; 2236 journals had annual distribution revenue below 100 000 yuan (not including), accounting for 56.92%; and 296 journals had annual distribution revenue of 1 million yuan and above, accounting for 7.54%.

1.1.5.3 Advertising Business Methods and Revenue

Among the 5037 STM journals participating in the 2021 annual inspection, 4997 journals filled in data on "advertising management modes". The statistics show that 1678 journals (33.58%) had no advertising business (26 journals only placed public service advertisements); 2595 journals (51.93%) relied on self-operation advertising; 463 journals (9.27%) used "self-operation & commissioned" advertising, and 261 journals (5.22%) used commissioned advertising.

Among the 5006 journals that filled in "advertising revenue" data in the 2021 annual inspection, 1898 journals (37.91%) reported advertising revenue. The statistics (table 1.20) show that 596 journals had annual advertising revenue below 100 000 yuan, accounting for 31.40%; 1130 journals had annual advertising revenue below 300 000 yuan, accounting for 59.54%; and 256 journals had annual advertising revenue of 1 million yuan and above, accounting for 13.49%.

Tab. 1.19 – Distribution revenue in 2021.

Distribution revenue/in thousand yuan	No. of journals	%	Distribution revenue/in thousand yuan	No. of journals	%	Distribution revenue/in thousand yuan	No. of journals	%
<50	1632	41.55	500 ∼	88	2.24	1500 ∼	53	1.35
50 ∼	604	15.38	600 ∼	73	1.86	2000 ∼	55	1.40
100 ∼	305	7.76	700 ∼	54	1.37	3000 ∼	41	1.04
150 ∼	216	5.50	800 ∼	37	0.94	5000 ∼	33	0.84
200 ∼	288	7.33	900 ∼	35	0.89	10 000 ∼	17	0.43
300 ∼	170	4.33	1000 ∼	41	1.04	Total	3928	100.00
400 ∼	130	3.31	1200 ∼	56	1.43			

Note: Among the 5037 data provided for the 2021 annual inspection, 31 journals which didn't provide this data and 1078 journals which filled in data with "0" were excluded in the statistical range.

Tab. 1.20 – China's STM journals advertising revenue in 2021.

Advertising revenue/in thousand yuan	No. of journals	%	Advertising revenue/in thousand yuan	No. of journals	%	Advertising revenue/in thousand yuan	No. of journals	%
<100	596	31.40	500 ~	81	4.27	1000 ~	104	5.48
100 ~	323	17.02	600 ~	56	2.95	1500 ~	51	2.69
200 ~	211	11.12	700 ~	43	2.27	2000 ~	51	2.69
300 ~	143	7.53	800 ~	47	2.48	3000 ~	50	2.63
400 ~	108	5.69	900 ~	34	1.79	Total	1898	100.00

Note: Among the 5037 data provided for the 2021 annual inspection, 31 journals which did not provide this data and 3108 journals which filled in data with "0" were excluded in the statistical range.

1.1.5.4 Copyright Revenue

Among the 5037 STM journals participating in the 2021 annual inspection, 5006 journals filled in data on "copyright revenue", and 1375 journals (27.47%) reported copyright revenue. The statistics (table 1.21) show that 483 journals had annual copyright revenue below 10 000 yuan, accounting for 35.13%; 902 journals had annual copyright revenue below 50 000 yuan, accounting for 65.60%; and 153 journals had annual copyright revenue of 500 000 yuan and above, accounting for 11.13%.

1.1.5.5 Overseas Publishing Revenue[6]

Among the 5037 STM journals that participated in the 2021 annual inspection, 5006 journals filled in relevant data on "overseas publishing revenue". Among them, 100 journals had overseas publishing revenue, accounting for 2.00%. The statistics show that there were 35 journals with annual overseas publishing revenue below 10 000 yuan; 15 journals with revenue between 10 000 yuan and 20 000 yuan; 10 journals with revenue between 20 000 yuan and 50 000 yuan; 13 journals with revenue between 50 000 yuan and 100 000 yuan; journals with revenue between 100 000 yuan and 200 000 yuan; 11 journals with revenue between 200 000 yuan and 500 000 yuan; and only 3 journals with revenue of 500 000 yuan and above.

[6]It should be noted that many journals are distributed overseas through China International Book Trading Corporation Ltd., but the overseas publishing revenue is relatively low. Furthermore, for some English journals co-published with overseas publishers, the sales revenues generated from such publications may directly be counted as expenditure and not included in the overseas publishing revenues of the editorial department. Therefore, the statistical results of "overseas publishing revenues" in the annual inspection are for reference only.

Tab. 1.21 – China's STM journals copyright revenue in 2021.

Copyright revenue/in thousand yuan	No. of journals	%	Copyright revenue/in thousand yuan	No. of journals	%
<10	483	35.13	500 ~	45	3.27
10 ~	419	30.47	700 ~	41	2.98
50 ~	119	8.65	1000 ~	41	2.98
100 ~	91	6.62	2000 ~	17	1.24
200 ~	49	3.56	3000 ~	9	0.65
300 ~	61	4.44	Total	1375	100.00

Note: Among the 5037 data provided for the 2021 annual inspection, 31 journals which did not provide this data and 3631 journals which filled in data with "0" were excluded in the statistical range.

1.1.5.6 Project Activity Revenue

Regarding the "project activity revenue", among the 5037 STM journals that participated in the 2021 annual inspection, 5006 journals filled in relevant data. Among them, 607 journals had project activity revenue, accounting for 12.13%. The statistics (table 1.22) show that there were 130 journals with annual project activity revenue below 1 million yuan, accounting for 21.42%; 323 journals with annual project activity revenue below 4 million yuan, accounting for 53.21%; and 155 journals with annual project activity revenue of 1 million yuan and above, accounting for 25.54%.

Tab. 1.22 – China's STM journals project activity revenue in 2021.

Project activity revenue/in thousand yuan	No. of journals	%	Project activity revenue/in thousand yuan	No. of journals	%
<100	130	21.42	1000 ~	50	8.24
100 ~	88	14.50	1500 ~	26	4.28
200 ~	58	9.56	2000 ~	26	4.28
300 ~	47	7.74	3000 ~	30	4.94
400 ~	60	9.88	6000 ~	23	3.79
500 ~	25	4.12	Total	607	100.00
600 ~	44	7.25			

Note: Among the 5037 data provided for the 2021 annual inspection, 31 journals which did not provide this data and 4399 journals which filled in data with "0" were excluded in the statistical range.

1.1.5.7 New Media Investment and Revenue

Among the 5037 STM journals participating in the 2021 annual inspection, 5006 journals filled in data on "new media investment", among which 1515 journals had new media

Tab. 1.23 – China's STM journals new media investment in 2021.

Investment/in thousand yuan	No. of journals	%	Investment/in thousand yuan	No. of journals	%
<10	457	30.17	100 ~	80	5.28
10 ~	325	21.45	200 ~	55	3.63
20 ~	352	23.23	500 ~	22	1.45
40 ~	134	8.84	1000 ~	12	0.79
60 ~	78	5.15	Total	1515	100.00

Note: Among the 5037 data provided for the 2021 annual inspection, 31 journals which did not provide this data and 3491 journals which filled in data with "0" were excluded in the statistical range.

investment, accounting for 30.26%. The statistics (table 1.23) show that there were 457 journals with annual new media investment below 10 000 yuan (not including), accounting for 30.17%; 782 journals with annual new media investment below 20 000 yuan (not including), accounting for 51.62%; and 169 journals with annual new media investment of 100 000 yuan and above, accounting for 11.16%.

Among the 5037 STM journals participating in the 2021 annual inspection, 5006 journals filled in relevant data of "new media revenue", of which 355 journals had new media revenue, accounting for 7.09%. The statistics (table 1.24) show that there were 87 journals with annual new media revenue below 10 000 yuan, accounting for 24.51%; 196 journals with annual new media revenue below 40 000 yuan, accounting for 55.21%; and 104 journals with annual new media revenue of 100 000 yuan and above, accounting for 29.30%.

Tab. 1.24 – China's STM journals new media revenue in 2021.

Revenue/in thousand yuan	No. of journals	%	Revenue/in thousand yuan	No. of journals	%
<10	87	24.51	100 ~	34	9.58
10 ~	42	11.83	200 ~	32	9.01
20 ~	67	18.87	500 ~	16	4.51
40 ~	32	9.01	1000 ~	22	6.20
60 ~	23	6.48	Total	355	100.00

Note: Among the 5037 data provided for the 2021 annual inspection, 31 journals which did not provide this data and 4651 journals which filled in data with "0" were excluded in the statistical range.

1.1.5.8 Total Revenue

Among the 5037 STM journals participating in the 2021 annual inspection, 5006 journals filled in relevant data on "journal total revenues". After excluding invalid data, 4448 journals reported valid data, accounting for 88.85%. The statistics (table 1.25) show that there were

473 journals with annual total revenue below 100 000 yuan, accounting for 10.63%; 2424 journals with annual total revenue below 700 000 yuan, accounting for 54.50%; and 1481 journals with annual total revenues of 1 million yuan and above, accounting for 33.30%.

Tab. 1.25 – China's STM journals total revenues in 2021.

Total revenues/in thousand yuan	No. of journals	%	Total revenues/in thousand yuan	No. of journals	%	Total revenues/in thousand yuan	No. of journals	%
<100	473	10.63	800 ~	191	4.29	2500 ~	105	2.36
100 ~	379	8.52	900 ~	165	3.71	3000 ~	149	3.35
200 ~	364	8.18	1000 ~	237	5.33	4000 ~	117	2.63
300 ~	378	8.50	1200 ~	187	4.20	6000 ~	97	2.18
400 ~	335	7.53	1400 ~	125	2.81	10 000 ~	95	2.14
500 ~	265	5.96	1600 ~	117	2.63	Total	4448	100.00
600 ~	230	5.17	1800 ~	93	2.09			
700 ~	187	4.20	2000 ~	159	3.57			

Note: Among the 5037 data provided for the 2021 annual inspection, 31 journals which did not provide this data and 588 journals which filled in data with "0" were excluded in the statistical range.

1.1.5.9 Total Expenditure[7]

Among the 5037 STM journals participating in the 2021 annual inspection, 5006 journals filled in relevant data on "journal total expenditure". After excluding invalid data, 4665 journals reported valid data, accounting for 93.19%. The statistics (table 1.26) show that there were 198 journals with annual total expenses below 100 000 yuan, accounting for 4.24%; 2431 journals with annual total expenditure of less than 700 000 yuan, accounting for 52.11%; and 1543 journals with annual total expenses of 1 million yuan and above, accounting for 33.08%.

Among the 5037 STM journals participating in the 2021 annual inspection, 5006 journals filled in relevant data on "total employee training expenses". After getting rid of invalid data, 3388 journals (excluding journals with data of "0") reported valid data, accounting for 67.68%. The statistics (table 1.27) show that there were 1270 journals with annual employee training expenses below 10 000 yuan, accounting for 37.49%; 3051 journals with annual employee training expenses below 50 000 yuan, accounting for 90.05%; and 79 journals with annual employee training expenses of 100 000 yuan and above, accounting for 2.33%.

[7][Due to the differences in understanding of the data providers, some of the items may only include the printing expenditures of the journals, while others may include various expenditures such as personnel salaries and fixed assets. Therefore, the statistical results of total expenditure in the annual inspection are for reference only.]

Tab. 1.26 – China's STM journals total expenses in 2021.

Total expenses/in thousand yuan	No. of journals	%	Total expenses/in thousand yuan	No. of journals	%	Total expenses/in thousand yuan	No. of journals	%
<100	198	4.24	700 ~	283	6.07	1800 ~	107	2.29
100 ~	369	7.91	800 ~	221	4.74	2000 ~	177	3.79
200 ~	402	8.62	900 ~	187	4.01	2500 ~	112	2.40
300 ~	439	9.41	1000 ~	245	5.25	3000 ~	138	2.96
400 ~	410	8.79	1200 ~	213	4.57	4000 ~	108	2.32
500 ~	331	7.10	1400 ~	159	3.41	6000 ~	154	3.30
600 ~	282	6.05	1600 ~	130	2.79	Total	4665	100.00

Note: Among the 5037 data provided for the 2021 annual inspection, 31 journals which didn't provide this data and 341 journals which filled in data with "0" were excluded in the statistical range.

Tab. 1.27 – Training expenses for journal staff in 2021.

Training expenses/in thousand yuan	No. of journals	%	Training expenses/in thousand yuan	No. of journals	%
<5	736	21.72	30 ~	257	7.59
5 ~	534	15.76	40 ~	130	3.84
10 ~	625	18.45	50 ~	197	5.81
15 ~	252	7.44	70 ~	61	1.80
20 ~	431	12.72	100 ~	79	2.33
25 ~	86	2.54	Total	3388	100.00

Note: Among the 5037 data provided for 2021 annual inspection, 31 journals which did not provide this data and 1618 journals which filled in data with "0" were excluded in the statistical range.

1.1.6 Development Progress of New Media for Journals

1.1.6.1 Annual Visits to Journal Websites

Based on the data from the *National Journal Annual Inspection Report 2021*, among the 5037 STM journals, 2859 journals reported the number of annual visits to their journal websites (56.76%). Statistics show (table 1.28) that 733 journals (35.14%) received less than 50 000 visits per year to their sites; 1053 journals (50.48%) received less than 100 000 annually visits to their sites; and 200 journals (9.59%) received over 1 000 000 annually visits.

1.1.6.2 Official Mobile Device Applications

Based on the data from the *National Journal Annual Inspection Report 2021*, among the 5037 STM journals, 2587 journals reported the data of their mobile device applications (hereinafter "mobile apps") (51.36%). According to the statistics, 541 journals reported the data of their official mobile apps (20.91%), and 2046 journals have not developed any apps

Tab. 1.28 – Annual website visits of China's STM journals (2021).

Visits (in thousands)	Number of journals	%	Visits (in thousands)	Number of journals	%
<50	733	35.14	1000 ~	71	3.40
50 ~	320	15.34	1500 ~	36	1.73
100 ~	337	16.16	2000 ~	39	1.87
200 ~	255	12.22	3000 ~	43	2.06
400 ~	135	6.47	5000 ~	11	0.53
600 ~	106	5.08	Total	2086	100.00

Note: *National Journal Annual Inspection Report 2021* listed data of 5037 journals, among which 2178 journals did not report the data of annual visits to their websites, and 773 journals reported zero visits, which were not included in this table.

Tab. 1.29 – Mobile apps of China's STM journals by downloads (2021).

Download(s) (in thousands)	Number of journals	%
<10	122	26.75
10 ~	78	17.11
30 ~	45	9.87
50v	76	16.67
100 ~	52	11.40
200 ~	47	10.31
500 ~	20	4.39
1000 ~	12	2.63
2000 ~	4	0.88
Total	456	100.00

Note: Among 541 journals with official mobile apps, 51 journals did not report the download data; 34 journals reported zero downloads, which were not included in this table.

yet. And 416 journals were running one official mobile app (76.89%); 62 journals running 2 official apps (11.46%); 33 journals running 3 official apps (6.10%); 17 journals running 4 official apps (3.14%); and 13 journals running more than 5 official apps (2.40%).

Among 541 journals with official mobile apps, 490 journals reported the data of total downloads, including 456 journals with non-zero downloads. As shown in table 1.29, 122 journals generated less than 10 000 downloads or 26.75%, 245 journals within 50 000 downloads, or 53.73%; 36 journals generated more than 500 000 downloads, or 7.89%, from mobile device users.

Among 541 journals that were operating their own mobile apps, 464 STM journals reported the number of active subscribers. According to the statistics (table 1.30), 81 journals had 1000 or fewer active subscribers (19.06%) to their apps; 226 journals counted 7000 or fewer active subscribers (53.18%); and 39 journals had more than 100 000 active subscribers (9.18%).

Tab. 1.30 – Number of active subscribers of mobile device apps of China's STM journals, 2021.

Number of active users	Number of journals	%
<1000	81	19.06
1000 ~	74	17.41
3000 ~	44	10.35
5000 ~	27	6.35
7000 ~	25	5.88
10 000 ~	47	11.06
20 000 ~	35	8.24
50 000 ~	53	12.47
100 000 ~	38	8.94
1 000 000 ~	1	0.24
Total	425	100.00

Note: Among 541 journals which have mobile device apps, 77 journals did not report the number of active users, and 39 journals reported 0, which are not listed in this table.

1.1.6.3 Official WeChat Accounts

Based on the data from the *National Journal Annual Inspection Report 2021*, among the 5037 STM journals, 2194 journals created official accounts on Tencent's WeChat (accounting for 43.56%); 887 journals have not set up any WeChat account yet (17.61%); thus, data of 1956 journals were seen as invalid. According to the statistics, there were 2050 journals with one official WeChat account (93.44%); 114 journals with two accounts (5.20%); and 30 journals with more than 3 accounts (1.37%).

Among 2194 journals that owned official WeChat accounts, 1991 journals reported the number of their subscribers. As listed in table 1.31, 430 journals counted less than 1000 subscribers (not including), accounting for 22.34% of the 1991 journals; 1140 journals had less than 5000 (not including) subscribers, accounting for 59.22%; and 107 journals had more than 100 000 WeChat subscribers, occupying 5.56%.

Tab. 1.31 – Number of subscribers on official WeChat accounts of China's STM journals (2021).

Number of subscribers	Number of journals	%	Number of subscribes	Number of journals	%
<500	218	11.32	10 000 ~	176	9.14
500 ~	212	11.01	20 000 ~	170	8.83
1000 ~	274	14.23	50 000 ~	92	4.78
2000 ~	199	10.34	100 000 ~	97	5.04
3000 ~	237	12.31	500 000 ~	10	0.52
5000 ~	240	12.47	Total	1925	100.00

Note: Among 2194 STM journals with WeChat official accounts, 203 journals did not report the number of their subscribers on this platform, and 66 journals reported zero subscribers, which were not listed in this table.

Tab. 1.32 – Average views per post on official WeChat accounts of China's STM journals (2021).

Average views of each post	Number of journals	%	Average view of each post	Number of journals	%
<100	292	15.62	3000 ~	87	4.65
100 ~	300	16.05	5000 ~	36	1.93
200 ~	462	24.72	10 000 ~	20	1.07
500 ~	367	19.64	50 000 ~	3	0.16
1000 ~	302	16.16	Total	1869	100.00

Note: Among 2194 journals with official WeChat accounts, 275 journals did not report the data of average views per post they published, and 50 journals reported the data as 0, which were not included in this table.

Among the 2194 journals with official WeChat accounts, 1919 journals reported the average views per post (50 journals reported 0, seen as invalid). There were 292 journals (accounting for 15.62% of the 2194 journals) which received less than 100 views (not including) per post on average, while 1054 journals (56.39%) received less than 500 views (not including). And 23 journals (1.23%) received 10 000 average views per post, as shown in table 1.32.

Among 2194 journals which have created WeChat official accounts, 1726 journals reported the number of posts with over 100 000 annual pageviews on their WeChat accounts. Among the above, there were 133 journals (accounting for 7.71% of the 1726 journals) that published posts with over 100 000 annual pageviews. Statistics showed that 93 journals (accounting for 69.92% of the 133 journals) published less than 10 posts with over 100 000 annual pageviews; 23 journals (17.29%) reported 10 to 100 such posts; and 17 journals (12.78%) achieved more than 100 such posts.

1.1.6.4 Official Weibo Account

5005 journals ticked the option of an Official Weibo Account. Among the above journals, there were 4412 journals not operating any official Weibo account, accounting for 88.15%; 593 journals have created at least one account on Weibo (11.85%). Within these 593 journals, 571 journals were operating one account on Weibo, accounting for 96.29% of the total 593 journals; 20 journals were operating 2 accounts (3.37%); and 2 journals operating 3 accounts.

Among China's 593 STM journals with official Weibo accounts, 433 journals reported the data of their followers. As listed in table 1.33, 78 journals (accounting for 18.66% of the 433 journals) have less than 500 (not including) followers, while 209 or 50.00% of journals reporting less than 5000 followers (not including), and 57 most followed journals (13.64%) achieved more than 100 000 followers on the platform of Weibo.

TAB. 1.33 – Number of followers on Weibo accounts of China's STM journals (2021).

Number of follower	Number of journals	%	Number of followers	Number of journals	%
<500	78	18.66	30 000 ∼	19	4.55
500 ∼	82	19.62	50 000 ∼	22	5.26
2000 ∼	49	11.72	100 000 ∼	55	13.16
5000 ∼	42	10.05	1 000 000 ∼	2	0.48
10 000 ∼	69	16.51	Total	418	100.00

Note: *The National Journal Annual Inspection Report 2021* collects data from 5037 journals. Among 593 STM journals that have launched their own official Weibo accounts, 160 journals did not report the data of followers, and 15 journals reported zero followers, which were not included in this table.

Chapter 2

Impact Analysis of China's STM Journals

Junhong WU, Yanqin WENG, Xiukun SUN, Wanzhen XU, Yue XIAO, Shenyi HUANG and Qiwen YANG

Abstract

Current Situation of Papers Published by China's STM Journals

Papers Published by Chinese language STM Journals

According to CNKI data, in 2020, the 4164 CNKI-indexed Chinese language STM journals published a total of over 1.22 million citable papers. Among 60 disciplines, there were 33 disciplines with over 10 000 papers published. These 33 disciplines accounted for 89.35% of the total volume of papers.

In 2020, the top five regions ranked by the number of papers published in Chinese language STM journals were Beijing (122 776 papers, 9.33%), Jiangsu (112 752 papers, 8.57%), Guangdong (92 283 papers, 7.02%), Henan (78 240 papers, 5.95%), and Shandong (76 978 papers, 5.85%).

In 2020, among all institutions publishing STM papers in the Chinese language, higher-education institutions accounted for 30.66%; medical institutions accounted for 25.76%; enterprises and research institutes accounted for 16.89% and 9.20% respectively. The remaining papers were from other sources.

In 2020, there were 503 400 funded papers published in Chinese language STM journals, accounting for 41.26% of all papers (1.22 million). The top 10 funds with the largest number of funded papers in order, were: the National Natural Science Foundation of China, the National Key R&D Program of China, the National Social Science Fund of China, Henan Science and Technology Foundation, China Postdoctoral Science Foundation, and provincial natural science funds such as the ones in Jiangsu, Shandong, Shaanxi, Guangdong, Zhejiang and Hunan.

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In 2020, Chinese language STM journals published 6718 papers with author affiliations from outside of China, including 2160 foreign-authored papers[1] and 4558 foreign co-authored papers.[2]

Papers Published by China's SCI-indexed STM Journals

The number of papers published in China's SCI-indexed STM journals (China's SCI journals hereinafter) represents a small percentage of the total number of SCI-indexed papers from Chinese authors. In 2021, Chinese authors published 642 391 SCI papers in total, accounting for 27.40% of 2 344 852 papers worldwide. For the same period, 35 045 papers were published by 232 China's SCI journals, accounting for 1.49%. The number of SCI papers published by Chinese authors was 18.33 times as large as the number of papers published in China's SCI journals. Papers published by Chinese authors were the main source of papers published in China's SCI journals, with a total of 30 006 papers. Chinese authors contributed 85.62% of the papers published by China's SCI journals (83.81% in 2020). Compared with the volume of papers published by Chinese authors, the volume of papers published by China's SCI journals cannot serve the needs of publication in reality.

The total cites (1 953 643 times) to the papers written by Chinese authors in 2021 accounted for 33.16% of the total cites (5 892 128 times) to the world's papers. The total cites (124 728 times) to the papers published by China's SCI journals accounted for 2.12% of the total citations to the world's papers for the same period.

In 2021, the citation impact of papers published by China's SCI journals was 3.56 (2.82 in 2020); the citation impact of SCI papers published by Chinese authors was 3.04; both were higher than the citation impact (2.51) of the world's papers for the same period. For the first time, the citation impact of papers published by China's SCI journals in 2021 exceeded the citation impact of papers published by Chinese authors in all journals globally.

In 2021, there were 722 highly-cited papers published by China's SCI journals, accounting for 3.11% of the global highly-cited papers for the same period (23 237 papers). There were 8838 highly-cited papers published by Chinese authors, accounting for 38.03% of the global total of highly-cited papers for the same period.

In 2021, there were 16 008 Q1 (first quartile in the category, *i.e.*, top 25% of journals in a particular field based on Impact Factor) papers published by China's SCI journals, accounting for 1.62% of the world's Q1 papers for the same period (989 970 papers). There were 310 008 Q1 papers published by Chinese authors, accounting for 31.31% of the global total Q1 papers for the same period.

In 2021, 112 of China's SCI journals (accounting for 48.28%) published highly-cited papers; 44 of China's SCI journals (accounting for 18.97%) published hot papers.

In 2021, there were 15 countries that published over 50 000 papers each. Among them, China ranked first in terms of the number of papers published, fifth in terms of the number of papers published in China's SCI journals, and first both in terms of citation impact and category normalized citation impact (CNCI hereinafter). USA ranked second in terms of

[1]"Foreign-authored papers" are papers published in China's STM journals by foreign authors as the first authors.

[2]"Foreign co-authored papers" are papers published in China's STM journals by Chinese authors as the first authors in cooperation with other foreign authors.

papers published by its authors, first both in terms of SCI journals and the number of papers published, and fourth both in terms of citation impact and CNCI. UK ranked second both in terms of the number of STM journals and the number of papers published, and third in terms of papers published by its authors, citation impact and CNCI. Germany ranked fourth in terms of the number of STM journals, of papers published by its authors, and of papers published by STM journals, fifth in terms of citation impact, and sixth in terms of CNCI. India ranked fifth in terms of the number of papers published by its authors, twelfth in terms of the number of papers published by journals, and fifteenth both in terms of citation impact and CNCI.

From 2012 to 2021, a total of 4 399 639 Chinese researchers published 3 567 419 papers worldwide, accounting for 20.63% of the global papers. During the same period, Chinese authors published 45 369 highly-cited papers, accounting for 26.28% of the world's highly-cited papers.

Academic Influence of China's STM Journals

The academic influence of China's Chinese language STM journals is gradually increasing. Based on the data from the *Annual Report for China's Academic Journals Impact Factor 2017–2021 editions*, the average citable documents per Chinese language STM journal decreased from 289.36 papers in 2016 to 276.68 papers in 2020, showing an overall declining trend (the total decrease is 4.38%). However, it was still greater than the international average (according to the Journal Citation Report (2020) released by Clarivate, the average number of cited documents per journal of international STM journals was 213.29 papers). During the period from 2016 to 2020, the total domestic cites to Chinese language STM journal accounted for 95.11% of the total cites, which means the main influence of Chinese language STM journals is within China.

The total downloads of Chinese language STM journals increased from 272 million times in 2016 to 411 million times in 2020, showing an overall increasing trend with an average annual growth rate of 10.90%. The annual web downloads were also trending upwards year-on-year, rising from 26 331 600 times in 2016 to 88 677 100 times in 2020. This represents a 236.77% increase in 2020 over 2016. In terms of the average annual download rate per journal, there was also a rising trend year by year, from 29.8 times in 2016 to 88.86 times in 2020, a total growth of 198.19% in 5 years, with an average annual growth rate of 31.41%.

According to the *China Academic Journal International Citation Annual Report* 2017–2021 editions, the proportion of international citations of Chinese language STM journals was 4.44% in 2016 and 7.60% in 2020. The frequency of international citations of Chinese language STM journals was steadily increasing. The WJCI Report 2021 edition reported a total of 1218 Chinese language STM journals, of which 114 journals ranked in the top 25% (the first quartile, *i.e.*, Q1) of the World Journal Citation Index (WJCI) discipline ranking, accounting for 9.36% of Chinese language journals indexed.

China's English language STM journals are taking an increasingly important role and status in international academic exchange. From 2016 to 2020, both the total times cited by domestic and international papers and the average times cited per journal kept increasing with the annual average growth rate of the former being 15.03% and the latter being 10.35%. Over the past five years, the international total times cited in China's STM journals exceeded the domestic times cited, and the proportion of international times cited

rapidly increased from 245 600 in 2016 to 596 500 in 2020, with an average annual growth rate of 24.84%. The proportion of international times cited increased from 54.75% in 2016 to 75.98% in 2020. The average comprehensive impact factor of China's English STM journals was 0.901 in 2020, an increase of 7.65% compared with the previous year and an increase of 20.13% compared with 2016, with an average annual growth rate of 4.69%. The composite immediacy index per journal was 0.241 in 2020, an increase of 41.76% compared with the previous year and an increase of 72.14% compared with 2016, with an average annual growth rate of 14.54%. With the rapid development of China's science and technology, China's English language STM journals were indexed by an increasing number of world-renowned databases.

2.1 Impact Analysis of Chinese Language STM Journals

2.1.1 Status of Publication

This section takes the 4164 Chinese language STM journals indexed by CNKI[3] as the statistical scope and analyzes the number of papers, disciplinary distribution, institutional distribution, funded papers, international cooperation, etc. in 2020.

2.1.1.1 Disciplinary Distribution of Chinese Language STM Journals

A total of 1.22 million citable articles were published in 4164 Chinese language STM journals in 2020. This book refers to the *Annual Report for Chinese Academic Journals Impact Factors (Natural Sciences and Engineering Technologies Journals)* (hereinafter *Annual Impact Factor Report*) and analyzes the journals in 60 disciplines. Among the 1.22 million citable papers, about 159 900 papers were in Social Sciences or cross Social Sciences, and about 1.06 million papers were in the field of STM disciplines with some papers categorized 2 or more disciplines. Table 2.1 lists the distribution of Chinese language STM journals by discipline. Among 60 disciplines, there were 33 in which over 10 000 papers were published, accounting for 89.35% of the total papers. Five disciplines each accounted for more than 5% of the total number of papers, in the descending order of Automation Technology, Computer Technology (86 121 papers, accounting for 7.19%), Civil Engineering (74 592 papers, accounting for 6.23%), Transportation Engineering (74 555, 6.22%), Internal Medicine (69 030, 5.76%) and Nursing (61 223, 5.11%).

2.1.1.2 Regional Distribution of Chinese Language STM Journals by Places of Publication

Based on the statistical results of locations of all the publishing institutions in China (excluding Hong Kong, Macao and Taiwan) as displayed in table 2.2, the region with the highest number of papers published in Chinese language STM journals was Beijing

[3]China National Knowledge Infrastructure, developed by China Academic Journals (CD Edition) Electronic Publishing House. Website: www.cnki.net.

Tab. 2.1 – Number of papers in Chinese language STM journals by discipline in 2020.

No.	Discipline	No. of papers	%
1	Automation Technology, Computer Technology	86 121	7.19
2	Civil Engineering	74 592	6.23
3	Transportation Engineering	74 555	6.22
4	Internal Medicine	69 030	5.76
5	Nursing	61 223	5.11
6	Traditional Chinese Medicine & Pharmacology	59 693	4.98
7	Electrical Engineering	48 080	4.01
8	Surgery	46 610	3.89
9	Oncology	45 901	3.83
10	Environmental Science & Technology	45 085	3.76
11	Radio Electronics, Telecommunications Technology	35 458	2.96
12	Obstetrics, Gynecology & Pediatrics	35 132	2.93
13	Chemical Engineering	33 808	2.82
14	Animal Husbandry, Veterinary Science	28 942	2.42
15	Clinical Comprehensive Medicine	25 532	2.13
16	Mining Engineering Technology	23 734	1.98
17	Neurology & Psychiatry	23 209	1.94
18	Metal Science & Metalwork	22 018	1.84
19	Food Science & Technology	21 647	1.81
20	Agronomy	21 382	1.79
21	Chemistry	18 219	1.52
22	Geology	17 560	1.47
23	Oil & Gas Industry	17 305	1.44
24	Medicine & Health Care Administration	16 959	1.42
25	Horticulture	16 641	1.39
26	Hydraulic Engineering	15 958	1.33
27	Mechanical Engineering	15 946	1.33
28	Aeronautical and Space Science & Technology	13 200	1.10
29	Preventive Medicine & Hygiene	12 122	1.01
30	Forestry	11 937	1.00
31	Pharmacology	11 660	0.97
32	Plant Protection	10 892	0.91
33	Otorhinolaryngology & Ophthalmology	10 091	0.84
34	Light Industry (Excl Textile and Food)	9252	0.77
35	Biology	9177	0.77
36	Materials Science	9153	0.76
37	Mathematics	9029	0.75
38	Basic Agricultural Sciences	8617	0.72
39	Agricultural Engineering	7082	0.59
40	Surveying and Mapping Science and Technology	6661	0.56
41	Basic Medicine	6230	0.52
42	Basic Disciplines of Engineering and Technological Sciences	5788	0.48
43	Stomatology	5784	0.48

Tab. 2.1 – (continued).

No.	Discipline	No. of papers	%
44	Atmospheric Science	5671	0.47
45	Energy and Power Engineering	5306	0.44
49	Aquaculture	4951	0.41
47	Military and Specialized Medicine	4813	0.40
48	Metallurgical Engineering Technology	4772	0.40
49	Physics	3996	0.33
50	Earth Physics	3890	0.32
51	Dermatology and Venereology	3713	0.31
52	Textile Science and Technology	3367	0.28
53	Marine Sciences	2768	0.23
54	Weapon Industry and Military Technology	2238	0.19
55	Nuclear Science and Technology	1681	0.14
56	Mechanics	1456	0.12
57	Safety Science and Technology	940	0.08
58	Physical Geography	612	0.05
59	Astronomy	468	0.04
60	Systems Science	195	0.02
	Total	1 197 852	100.00

Note: Listed in descending order of the number of the papers published.
The data source from CNKI.
There are overlaps between disciplines, meaning that one paper may involve 2 or more disciplines.

(122 776, accounting for 9.33%), while the other regions occupying over 5% of papers published all over China were Jiangsu (112 752, 8.57%), Guangdong (92 283, 7.02%), Henan (78 240, 5.95%), and Shandong (76 978, 5.85%).

2.1.1.3 Distribution of Chinese Language STM Journals by Publishing Institutions

The number of papers published by various institutions in Chinese language STM journals in 2020 shows that higher education institutions accounted for 30.66% of the publications [higher education institutions refer to undergraduate institutions in general higher education institutions nationwide, excluding higher vocational (junior college) institutions and adult higher education institutions], medical institutions accounted for 25.76%, enterprises accounted for 16.89%, research institutes accounted for 9.20%, and other institutions accounted for 17.48% [other institutions include public institutions, higher vocational (junior college) institutions, adult higher education institutions, primary and secondary schools, kindergartens, etc.] (figure 2.1).

Table 2.3 lists the composition of the types of institutions publishing papers in Chinese language STM journals in various disciplines.

1) There are eight disciplines in which the proportion of papers published by higher education institutions exceeded 70%, namely "mechanics" (90.18%), "mathematics" (88.61%), "physics" (86.62%), "systematic Science" (82.05%), "materials science"

Tab. 2.2 – Regional distribution of papers published in Chinese language STM journals in 2020 (excluding Hong Kong, Macau and Taiwan).

No.	Region	No. of papers	%	No.	Region	No. of papers	%
1	Beijing	122 776	9.33	17	Gansu	36 845	2.80
2	Jiangsu	112 752	8.57	18	Guangxi	30 680	2.33
3	Guangdong	92 283	7.02	19	Tianjin	30 004	2.28
4	Henan	78 240	5.95	20	Heilongjiang	29 490	2.24
5	Shandong	76 978	5.85	21	Jiangxi	29 483	2.24
6	Shanghai	57 738	4.39	22	Yunnan	24 307	1.85
7	Shaanxi	55 962	4.25	23	Jilin	24 145	1.84
8	Liaoning	54 352	4.13	24	Chongqing	22 762	1.73
9	Zhejiang	53 977	4.10	25	Guizhou	21 651	1.65
10	Hubei	52 410	3.98	26	Xinjiang	20 949	1.59
11	Sichuan	51 940	3.95	27	Inner Mongolia	16 052	1.22
12	Hebei	41 628	3.16	28	Ningxia	7011	0.53
13	Hunan	39 454	3.00	29	Qinghai	6777	0.52
14	Fujian	38 806	2.95	30	Hainan	6767	0.51
15	Anhui	38 793	2.95	31	Tibet	2037	0.15
16	Shanxi	38 250	2.91		Total	1 315 299	100.00

Note: Listed in the descending order of the number of published papers.
Data source is CNKI.
Cross-regional collaborative papers were counted in multiple regions.

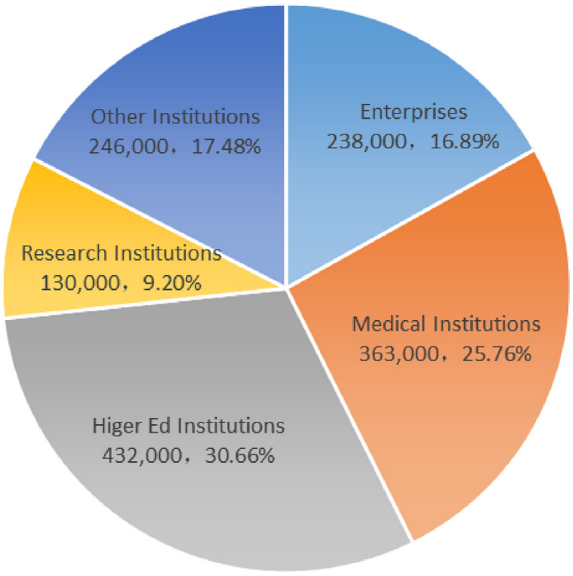

Fig. 2.1 – Distribution of Chinese language STM journals by publishing institutions 2020.

Tab. 2.3 – Distribution by type of institutions publishing papers in Chinese language STM journals in various disciplines 2020.

No.	Discipline	No. of papers in this discipline	Higher Ed Inst		Medical Inst		Enterprise		Research Inst		Others	
			No. of papers	%	No. of papers	%	No. of papers	%	No. of papers	%	No. of papers	%
1	Automation technology, Computer technology	85 881	52 440	61.06	2811	3.27	16 434	19.14	7170	8.35	18 485	21.52
2	Civil engineering	74 313	29 721	39.99	324	0.44	32 281	43.44	9302	12.52	12 150	16.35
3	Transportation engineering	74 143	22 929	30.93	30	0.04	41 776	56.35	8528	11.50	12 805	17.27
4	Internal medicine	68 985	8759	12.70	64 897	94.07	293	0.42	1134	1.64	1492	2.16
5	Nursing	61 210	4520	7.38	58 256	95.17	61	0.10	132	0.22	1678	2.74
6	Traditional Chinese medicine & pharmacology	59 667	26 891	45.07	43 091	72.22	1794	3.01	3584	6.01	3103	5.20
7	Electrical engineering	48 029	20 099	41.85	51	0.11	27 185	56.60	6474	13.48	5675	11.82
8	Surgery	46 586	3843	8.25	45 625	97.94	88	0.19	283	0.61	493	1.06
9	Oncology	45 883	6126	13.35	43 695	95.23	197	0.43	453	0.99	584	1.27
10	Environmental science & technology	44 992	21 771	48.39	397	0.88	12 371	27.50	8782	19.52	12 140	26.98
11	Radio electronics, Telecommunications	35 361	17 448	49.34	279	0.79	11 291	31.93	4497	12.72	7097	20.07
12	Obstetrics, gynecology & pediatrics	35 120	2223	6.33	34 161	97.27	76	0.22	291	0.83	636	1.81
13	Chemical engineering	33 652	16 680	49.57	353	1.05	14 775	43.91	4478	13.31	3484	10.35
14	Animal husbandry, Veterinary medicine	28 760	9507	33.06	1801	6.26	2624	9.12	4634	16.11	16 351	56.85
15	Clinical medicine (General)	25 522	2865	11.23	23 856	93.47	232	0.91	500	1.96	639	2.50
16	Mining engineering & technology	23 717	5640	23.78	5	0.02	17 979	75.81	2033	8.57	2210	9.32
17	Neurology & psychiatry	23 192	3704	15.97	21 546	92.90	50	0.22	285	1.23	459	1.98
18	Metal science & metalwork	21 958	11 128	50.68	17	0.08	9926	45.20	2939	13.38	3179	14.48
19	Food science & technology	21 633	13 154	60.81	636	2.94	3958	18.30	4269	19.73	5047	23.33
20	Agronomy	21 309	8481	39.80	102	0.48	2201	10.33	8143	38.21	8454	39.67
21	Chemistry	18 217	11 756	64.53	830	4.56	2939	16.13	3160	17.35	3427	18.81
22	Geology	17 551	6840	38.97	5	0.03	5504	31.36	5250	29.91	6697	38.16
23	Oil & gas industry	17 297	4592	26.55	3	0.02	13 428	77.63	2147	12.41	936	5.41
24	Health & medicine administration	16 937	4467	26.37	12 899	76.16	288	1.70	610	3.60	1492	8.81
25	Horticulture	16 488	5753	34.89	44	0.27	1341	8.13	5674	34.41	7451	45.19
26	Mechanical engineering	15 931	8006	50.25	235	1.48	4571	28.69	2280	14.31	3353	21.05
27	Hydraulic engineering	15 930	3458	21.71	12	0.08	5196	32.62	3988	25.03	6237	39.15

Tab. 2.3 – (continued).

28	Aeronautical and space science & technology	13 179	6339	48.10	6	0.05	3437	26.08	4637	35.18	1948	14.78
29	Preventive medicine & hygiene	12 085	3351	27.73	8615	71.29	499	4.13	963	7.97	1201	9.94
30	Forestry	11 899	3826	32.15	77	0.65	559	4.70	3063	25.74	7095	59.63
31	Pharmacology	11 653	3261	27.98	7825	67.15	783	6.72	988	8.48	1179	10.12
32	Plant protection	10 848	3988	36.76	136	1.25	685	6.31	3516	32.41	5408	49.85
33	Otorhinolaryngology & ophthalmology	10 075	1187	11.78	9569	94.98	38	0.38	128	1.27	192	1.91
34	Biology	9173	7366	80.30	387	4.22	340	3.71	2576	28.08	1597	17.41
35	Light industry (Excl textile & food)	9154	5180	56.59	39	0.43	2390	26.11	649	7.09	2055	22.45
36	Material sciences	9139	7469	81.73	83	0.91	1486	16.26	1405	15.37	742	8.12
37	Mathematics	9026	7998	88.61	125	1.38	297	3.29	306	3.39	1105	12.24
38	Agricultural basic sciences	8604	4515	52.48	6	0.07	845	9.82	2735	31.79	3309	38.46
39	Agricultural engineering	7056	2508	35.54	0	0.00	795	11.27	1321	18.72	3566	50.54
40	Surveying and mapping science & technology	6657	2742	41.19	5	0.08	1241	18.64	1838	27.61	2385	35.83
41	Basic medicine	6224	3644	58.55	2956	47.49	291	4.68	736	11.83	357	5.74
42	Stomatology	5783	908	15.70	5362	92.72	39	0.67	28	0.48	164	2.84
43	Engineering & technology science basic disciplines	5744	3969	69.10	17	0.30	1135	19.76	670	11.66	778	13.54
44	Atmospheric sciences	5668	2123	37.46	4	0.07	215	3.79	1373	24.22	3943	69.57
45	Energy & power engineering	5298	3075	58.04	9	0.17	2203	41.58	801	15.12	513	9.68
46	Aquaculture	4903	2611	53.25	36	0.73	592	12.07	1934	39.45	1550	31.61
47	Military medicine & special medicine	4810	551	11.46	4409	91.66	56	1.16	97	2.02	132	2.74
48	Metallurgic Engineering & technology	4766	1524	31.98	3	0.06	3455	72.49	458	9.61	231	4.85
49	Physics	3991	3457	86.62	21	0.53	266	6.66	671	16.81	292	7.32
50	Geophysics	3889	1597	41.06	3	0.08	276	7.10	1244	31.99	2209	56.80
51	Dermatology & venereology	3711	415	11.18	3497	94.23	22	0.59	117	3.15	63	1.70
52	Textile science & technology	3341	1898	56.81	7	0.21	1027	30.74	252	7.54	749	22.42
53	Marine sciences	2766	1701	61.50	0	0.00	518	18.73	979	35.39	697	25.20
54	Weapon industry & military technology	2237	1297	57.98	2	0.09	509	22.75	692	30.93	426	19.04
55	Nuclear science & technology	1681	814	48.42	24	1.43	342	20.35	942	56.04	121	7.20
56	Mechanics	1456	1313	90.18	15	1.03	121	8.31	204	14.01	93	6.39

Tab. 2.3 – (continued).

No.	Discipline	No. of papers in this discipline	Higher Ed Inst		Medical Inst		Enterprise		Research Inst		Others	
			No. of papers	%	No. of papers	%	No. of papers	%	No. of papers	%	No. of papers	%
57	Safety science & technology	926	416	44.92	3	0.32	276	29.81	160	17.28	190	20.52
58	Natural geography	612	441	72.06	0	0.00	36	5.88	230	37.58	152	24.84
59	Astronomy	468	380	81.20	1	0.21	16	3.42	253	54.06	39	8.33
60	Systems sciences	195	160	82.05	2	1.03	18	9.23	21	10.77	20	10.26
	Total	1 195 281	424 825	35.54	399 205	33.40	253 667	21.22	137 007	11.46	190 255	15.92

Note: Ranked in descending order by the number of papers published in each discipline.
Numbers in this list are based on the institution type of the authors' affiliations.
The data source is CNKI.
"%" is the percentage of papers published by institutions of this category in question against the total number of papers in this discipline.
There is overlap in counting the institutions since a paper that crosses multiple disciplines or is co-authored by multiple types of institutions will be counted separately.

(81.73%), "astronomy" (81.20%), "biology" (80.30%), and "physical geography" (72.06%).

2) Medical institutions are the main contributors to papers published in various fields of clinical medicine, with only "pharmacy" and "basic medicine" having a proportion of papers lower than 70%. The disciplines with the highest proportion of papers published by medical institutions are "surgery" (97.94%), "obstetrics & gynecology and pediatric" (97.27%), "oncology" (95.23%), "nursing science" (95.17%), "otorhinolaryngology and ophthalmology" (94.98%), "dermatology and venereology" (94.23%), "internal medicine" (94.07%), "comprehensive clinical medicine" (93.47%), "neurology and psychiatry" (92.90%), "dentistry" (92.72%), and "military medicine and special medicine" (91.66%).

3) The top ten disciplines with a higher proportion of papers published by enterprises are "petroleum and natural gas industry" (77.63%), "mining engineering technology" (75.81%), "metallurgical engineering technology" (72.49%), "electrical engineering" (56.60%), "transportation engineering" (56.35%), "metallurgy and metalworking" (45.20%), "chemical engineering" (43.91%), "civil engineering" (43.44%), "energy and power engineering" (41.58%), and "hydraulic engineering" (32.62%).

4) The top ten disciplines with the highest percentage of papers published by research institutes are, in descending order, "nuclear science and technology" (56.04%), "astronomy" (54.06%), "aquaculture" (39.45%), agronomy (38.21%), "physical geography" (37.58%), "marine sciences" (35.39%), "aeronautical, aerospace science and technology" (35.18%), "horticulture" (34.41%), "plant protection" (32.41%) and "geophysics" (31.99%).

2.1.1.4 Analysis of Funded Papers Published by Chinese Language STM Journals

Papers generated from the results of research projects supported by funds are called funded papers. In 2020, a total of 503 400 funded papers were published in Chinese language STM journals, accounting for 41.26% of the total papers (1.22 million papers). The 10 funds supporting the largest number of papers are displayed in table 2.4. It can be seen that in addition to national funds such as the National Natural Science Foundation of China (NSFC) and the National Key Research and Development Program of China (NKRDP), funds at provincial level, such as funds in Henan, Jiangsu, Shandong and other regions also give a lot of support.

Table 2.5 lists the number of funded papers in various disciplines and their proportion among all papers in Chinese STM journals in 2020. There were 10 disciplines in which funded papers took up more than 70%, mostly in basic research fields, which were "biology" (86.36%), "astronomy" (83.12%), "mechanics" (78.98%), "physical geography" (78.27%), "mathematics" (76.94%), "physics" (76.70%), "marine science" (76.08%), "basic medicine" (74.94%), "material sciences" (74.57%) and "geophysics" (70.54%).

2.1.1.5 Analysis of Papers Published in Chinese Language STM Journals by Overseas Authors and in Collaboration with Overseas Authors

"Papers by overseas authors" refer to papers published in China's STM journals with the first authors from overseas. "Overseas collaboration papers" refers to papers with a Chinese

Tab. 2.4 – Major funding of papers published in Chinese language STM journals 2020.

No.	Name of funds	Number of papers
1	National Natural Science Foundation of China	146 700
2	National Key Research and Development Program of China	51 890
3	National Social Science Fund of China	5161
4	Henan Science and Technology Research Plan	5133
5	China Postdoctoral Science Foundation	4949
6	Jiangsu Natural Science Foundation	3532
7	Shandong Natural Science Foundation	3226
8	Shaanxi Natural Science Foundation	3076
9	Guangdong Natural Science Foundation	2977
10	Hunan Natural Science Foundation	2897

Note: Listed in descending order of the number of papers funded by major foundations or funds.
The data source is CNKI.

Tab. 2.5 – Number and proportion of funded papers published in Chinese language STM journals in various disciplines 2020 (Top 20).

No.	Disciplines	Number of papers	Number of funded papers	Percentage
1	Biology	9177	7925	86.36
2	Astronomy	468	389	83.12
3	Mechanics	1456	1150	78.98
4	Physical geography	612	479	78.27
5	Mathematics	9029	6947	76.94
6	Physics	3996	3065	76.70
7	Marine sciences	2768	2106	76.08
8	Basic medicine	6230	4669	74.94
9	Material sciences	9153	6825	74.57
10	Geophysics	3890	2744	70.54
11	Aquaculture	4951	3441	69.50
12	Food science and technology	21 647	14 841	68.56
13	Systems science	195	133	68.21
14	Chemistry	18 219	12 405	68.09
15	Basic agricultural sciences	8617	5672	65.82
16	Atmospheric science	5671	3666	64.64
17	Agronomy	21 382	13 726	64.19
18	Traditional Chinese medicine and pharmacology	59 693	37 389	62.64
19	Geology	17 560	10 308	58.70
20	Horticulture	16 641	9391	56.43

Note: Listed in descending order according to the percentage of funded papers.
This table counts all the papers supported by the fund, without limiting the level of funds.
The data source is CNKI.

author as the first author, but published in China's STM journals in collaboration with authors from other countries/regions. These 2 types of papers are called "overseas papers". In 2020, there were 6718 "overseas papers", among them 2160 papers by overseas authors, while 4558 papers were published by Chinese authors in collaboration with overseas authors.

The top five disciplines in which the most overseas papers are published in Chinese language STM journals are: "biology" (162 papers), "material sciences" (129), "mathematics" (121), "atmospheric sciences" (84), and "marine science" (68). The discipline with the highest percentage of both papers by overseas authors and overseas collaboration papers is "Astronomy" (table 2.6).

The number of papers published in Chinese language STM journals by first authors and co-authors from Hong Kong, Macao and Taiwan in 2020 are shown in table 2.7. Table 2.8 shows the papers by overseas first authors and co-authors.

2.1.2 Impact Analysis

Based on data from the *Annual Report for Chinese Academic Journals Impact Factors* and *Annual Report for International Citation of Chinese Academic Journals (Natural Science)* (hereafter referred to as *International Citation Annual Report*) published by CNKI, as well as the *World Journal Clout Index (WJCI) of Scientific and Technological Periodicals* (2020) (*WJCI Report* hereafter), the overall domestic and international influence of China's STM journals was analyzed.

The *Annual Report for Chinese Academic Journals Impact Factors* is published in CD-ROM which provides statistical data on the publication of academic papers by China's journals during the year, as well as citation data of journals, conference proceedings, and dissertations. Dozens of quantitative evaluation indexes are published, making it an authoritative reference tool for evaluating the academic impact of China's STM journals. The 2021 edition of the *Annual Report for Chinese Academic Journals Impact Factors* included 3966 journals, covering 3771 STM journals that participated in the annual verification, including 3516 Chinese language STM journals and 255 English language STM journals.

The *International Citation Annual Report* statistically analyzes China's 3372 STM journals cited by more than 21 000 international journals, books, and conference proceedings from various countries and regions around the world. It publishes multiple evaluation indexes every year, comprehensively revealing the international impact of China's STM journals. The comprehensive evaluation index of the *International Citation Annual Report* is called the "Clout Index" (CI). Based on the CI index, the top 5% of journals are selected as the "most internationally influential journals in China" (175 journals); the journals ranked between the top 5% and 10% are the "outstanding journals with international impact in China" (175 journals); these 2 types of journals are collectively referred to are "*TOP Journals*", totaling 350 journals. *The International Citation Annual Report* (2021) includes 2935 Chinese-language STM journals that participated in the annual inspection and 316 English-language STM journals.

World Journal Citation Impact Report (2021) was jointly developed by six institutions, including the Institute of Scientific and Technical Information of China, CNKI,

TAB. 2.6 – Number of overseas papers published in Chinese language STM journals in selected disciplines 2020.

No.	Discipline	Total no. of papers in this discipline (A)	Papers by overseas authors		Overseas cooperation papers		Overseas papers	
			No. of papers (B)	% ($B/A \times 100\%$)	No. of papers (C)	/% ($C/A \times 100\%$)	No. of paper ($B + C$)	/% [$(B + C)/A \times 100\%$]
1	Biology	9177	54	0.59	108	1.18	162	1.77
2	Material sciences	9153	34	0.37	95	1.04	129	1.41
3	Mathematics	9029	29	0.32	92	1.02	121	1.34
4	Atmospheric sciences	5671	20	0.35	64	1.13	84	1.48
5	Marine sciences	2768	10	0.36	58	2.10	68	2.46
6	Physics	3996	17	0.43	49	1.23	66	1.65
7	Geophysics	3890	8	0.21	46	1.18	54	1.39
8	Nuclear science and technology	1681	6	0.36	18	1.07	24	1.43
9	Astronomy	468	7	1.50	16	3.42	23	4.91
10	Mechanics	1456	4	0.27	18	1.24	22	1.51
11	Physical geography	612	3	0.49	7	1.14	10	1.63
12	Systems science	195	1	0.51	2	1.03	3	1.54

Note: Ranked by the total number of overseas papers.

The data source is CNKI.

In this table, "selected disciplines" refers to those disciplines in which the number of papers published in Chinese language STM journals by overseas authors or the number of papers co-authored by foreign authors accounts for more than 1% of the number of papers in the discipline.

Tab. 2.7 – Number of papers published in Chinese language STM journals by authors from Hong Kong, Macao and Taiwan in 2020.

No.	Region	No. of first-authored papers	No. of co-authored papers	Total no. of papers
1	Hong Kong	255	405	660
2	Macao	156	159	315
3	Taiwan	57	120	177

Tab. 2.8 – Number of papers published in Chinese language STM journals by overseas authors in 2020 (Top 20).

No.	Countries	No. of first-authored papers	No. of collaboration papers with Chinese authors	Total no. of papers
1	USA	471	1341	1812
2	UK	217	462	679
3	Japan	118	347	465
4	Australia	128	326	454
5	Canada	80	257	337
6	South Korea	137	132	269
7	Germany	59	167	226
8	Singapore	40	116	156
9	France	37	85	122
10	Netherlands	31	61	92
11	Italy	35	48	83
12	Russia	29	52	81
13	Denmark	9	57	66
14	Sweden	13	50	63
15	Thailand	25	36	61
16	Malaysia	16	43	59
17	New Zealand	6	41	47
18	Belgium	16	26	42
19	Switzerland	11	27	38
20	Finland	10	27	37

Note: Ranked in descending order of the total number of overseas papers.
The data source is CNKI.

Tsinghua University Library, Wanfang Data, the Society of China University Journals, and the China Editology Society of Science Periodicals. The report selects 14 665 journals out of 60 000 journals published globally to be the source data for the World Citation Library. The journals are selected as the most representative in terms of region, discipline, and industry. The selection standards are R&D input, amount of scientific research output, number of scientific researchers, and the scale and level of journals in

various countries and regions all over the world. The report creates a classification system that covers all fields of science and technology, reflecting the development of emerging and interdisciplinary fields, and divides into 291 subject categories. It conducts a quantitative evaluation of China's and international journals by subject under the same standards. The evaluation index "World Journal Clout Index Score" (WJCI) published by the report is built on two indicators: WAJCI which is based on citation data, representing journal academic impact and WI which is based on internet usage data, representing journal social impact. Compared with other journal evaluation systems currently in use, it can reflect the global influence of various STM journals more scientifically and comprehensively.

In the *World Journal Citation Impact Report*, journals are ranked by WJCI by discipline and divided into four zones, Quartile one, Quartile two, Quartile three, and Quartile four. The 2021 Report included 1584 journals from China, covering 1495 journals with annual inspection data (1218 Chinese language STM journals and 277 English language STM journals).

2.1.2.1 Citable Literature Per Journal

Citable literature generally refers to journal articles that have academic research results and can be cited by other academic papers during the research process. It is different from other non-innovative research papers, such as narrations, introductory, popular science materials, secondary literature, fiction, directories and indices. The quantity of citable literature in a journal is an important indicator of the amount of scientific research information that the journal disseminates. The amount of citable literature of Chinese language STM journals in the past five years was analyzed according to the *Annual Report for Chinese Academic Journals Impact Factors* to reflect the changes in the journals' accommodation of research information.

According to the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions (the statistical years are 2016–2020), the average number of citable articles in Chinese language STM journals decreased from 289.36 articles in 2016 to 276.68 articles in 2020, reflecting a decreasing trend and an overall drop of 4.38% (table 2.9). Yet the average number of citable articles per journal is still larger than that of international journals. According to *Journal Citation Reports* 2020 (*JCR*) published by Clarivate, the average number of annual citable literature (articles and reviews) of international STM journals is 213.29 articles.

Tab. 2.9 – Number of average citable articles in Chinese language STM journals 2016–2020.

Statistical year	No. of citable articles	No. of journals	No. of citable articles per journal
2016	970 789	3355	289.36
2017	965 679	3391	284.78
2018	986 516	3410	289.30
2019	984 779	3441	286.19
2020	972 803	3516	276.68

Data source: Annual Report for Chinese Academic Journals Impact Factors 2017–2021 editions.

2.1.2.2 Total Journal Citations

Total journal citations reflect the overall academic impact of the journal. The *Annual Report for Chinese Academic Journals Impact Factors* reports the composite total times cited for Chinese source journals, master's and doctoral dissertations, and conference proceedings. The composite total times cited represent the total number of citations received by all citable literature published by a journal since its launch during the statistical year, reflecting the overall influence of the journal in various scientific research and talent development activities. In 2020, the composite total cited times of Chinese language STM journals in China was 7 465 700. In terms of trend, after reaching a peak of 8 436 100 in 2017, it has been declining each year, and by 2020 it was 11.50% lower than its peak.

The citation count of the *International Citation Annual Report* is derived from the number of citations of more than 21 000 international journals, books, and academic conference proceedings. Chinese language STM journals in China were cited 605 800 times by the international literature in 2020. The trend of high growth has been maintained for five consecutive years, with an average annual increase of 12.38%.

Overall, the total number of times Chinese language STM journals were cited at home and abroad from 2016 to 2020 shows an increasing trend followed by a decline. It increased from 8.5481 million times in 2016 to 8.7722 million times in 2017 and then decreased to reach 7.9727 million times in 2020. In terms of the proportion, the domestic composite total times cited by Chinese language STM journals from 2016 to 2020 accounted for as much as 95.11% of the total times cited, indicating that the influence of Chinese language STM journals is mainly concentrated in China. The proportion of times cited from abroad was 4.44% in 2016, and increased to 7.60% in 2020, suggesting a gradual improvement in the international citation impact of Chinese language STM journals, as shown in table 2.10.

Tab. 2.10 – Citations of Chinese language STM journals at home and abroad 2016–2020.

Statistical year	No. of journals	Composite domestic citations (A)	Citations from abroad (B)	Total (A + B) (overlap removed)	Increase rate (%)
2016	3355	8 236 901	379 773	8 548 060	—
2017	3391	8 436 149	421 527	8 772 233	2.62
2018	3410	7 965 429	483 222	8 358 906	−4.71
2019	3441	7 675 175	620 322	8 200 389	−2.21
2020	3516	7 465 672	605 807	7 972 745	−2.46

Note: Data comes from the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2020 editions and *International Citation Annual Report* 2017–2020 editions.

Due to the fact that some Chinese language journals are included in the SCI Database and CNKI's *Annual Report for Chinese Academic Journals Impact Factors* at the same time, hence the overlapping citations in statistical data were removed when adding up total citations from home and abroad in order to ensure accuracy.

The increase rate is a year-on-year rate on the total citations at home and abroad.

2.1.2.3 Impact Factor and Immediacy Index

According to the data of the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions (the statistical years are 2016 to 2020), the average composite impact factor of Chinese Language STM journals was 0.670 in 2016, and 0.909 in 2020, showing an upward trend with an annual increase of 7.93%. The immediacy index per journal was 0.081 in 2016, and 0.167 in 2020, which also shows an upward trend with an average annual increase of 19.83% (see table 2.11).

According to the data of *International Citation Annual Report Editions 2017 to 2021* (the statistical years are 2016 to 2020), the average citation impact factor of Chinese language TOP journals of International Influence was 0.269 in 2016 and 0.547 in 2020, with an approximate annual increase of 19.41%. The immediacy index per journal in 2016 was 0.046, and 0.204 in 2020 with an annual increase of about 45.12% (table 2.11).

Tab. 2.11 – Impact factor and immediacy index of Chinese language STM journals 2016–2020.

Statistical year	Domestic influence			International influence (TOP journals)		
	No. of journals	Avg. composite impact factor	Avg. composite immediacy index	No. of journals	Avg. impact factor (without self-cites)	Avg. immediacy index
2016	3355	0.670	0.081	179	0.269	0.046
2017	3391	0.713	0.091	161	0.332	0.066
2018	3410	0.766	0.098	149	0.411	0.101
2019	3441	0.842	0.132	135	0.475	0.090
2020	3516	0.909	0.167	116	0.547	0.204

Note: Data source is the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions and *International Citation Annual Report* 2017–2021 editions.

2.1.2.4 Self-Citation Rate

The self-citation rate is the number of citations to a journal's own articles within the statistical year divided by the total number of citations. Journals with a self-citation rate of more than 20% are called highly self-cited journals. Based on the data from the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions, the average self-citation rate of a Chinese STM journal had been maintained at around 10.00%. In 2020, journals with a self-citation rate of less than 20% accounted for 87.51% of all journals. Journals with a self-citation rate higher than 20% accounted for 12.94% of all journals. Judging by the annual statistical change, the number of journals with a self-citation rate below 20% has increased (see table 2.12).

TAB. 2.12 – Distribution of self-citations of Chinese language STM journals 2016–2020.

Statistical year	No. of journals	Percentage of self-citation											
		0 ∼		10 ∼		20 ∼		30 ∼		40 ∼		50 ∼	
		No. of journals	%	No. of journals	%	No. of journals	%	No. of journals	%	No. of journals	%	No. of journals	%
2016	3355	1933	57.62	962	28.67	321	9.57	92	2.74	37	1.10	10	0.30
2017	3391	1975	58.24	999	29.46	295	8.70	90	2.65	21	0.62	11	0.32
2018	3410	1986	58.24	998	29.27	298	8.74	94	2.76	21	0.62	13	0.38
2019	3441	1992	57.89	1028	29.88	295	8.57	95	2.76	25	0.73	6	0.17
2020	3516	2017	57.37	1060	30.15	311	8.85	94	2.67	27	0.77	7	0.20

Note: The data source is the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions.
The percentage here refers to the percentage of the journals within each range of self-citation rate against the total number of journals.

2.1.2.5 Internet Dissemination Indices

The internet dissemination indices, which include total downloads, web immediacy downloads, and web immediacy download ratio, reflect the situation of full-text downloads of journal articles. The *Annual Report for Chinese Academic Journals Impact Factors* publishes download information based on all the download logs of CNKI's main servers, overseas servers, and mirror servers in China. To best reflect the true usage behavior of users, the methodology for tracking a download is a single count for one user from the same IP address using the same login details on the same day. Data cleaning is performed to effectively avoid errors caused by multi-threaded download software and duplicate downloads. "Total downloads" refers to the total number of full-text downloads of all documents published on the CNKI network in a statistical year for a specific journal. "Web immediacy downloads" refers to the total number of full-text downloads of documents published by CNKI in the same statistical year when they are published for a given journal. The "web immediacy download ratio" is calculated by dividing the web immediacy download by the total number of documents published online by the journal in that year, which represents the average number of downloads per article.

According to the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions (statistical years 2016–2020), the total downloads of Chinese language STM journals increased from 272 million times in 2016 to 411 million times in 2020, with an annual increase of 10.90%. The web immediacy download had increased from 26 331 600 in 2016 to 88 677 100 in 2020, with an increase of 236.77% in 2020 over 2016. The ratio of web immediacy downloads to total downloads had increased from 9.69% in 2016 to 21.57% in 2020, with an overall upward trend, increasing 122.60% in 2020 compared with 2016. The average web immediacy download ratio per journal also shows an increasing trend year by year, from 29.8 times in 2016 to 88.86 times in 2020, with a total increase of 198.19% in five years, with an average annual growth rate of 31.41% (table 2.13).

Tab. 2.13 – Downloads of Chinese language STM journals 2016–2020.

Statistical year	Total download times (A)	Immediacy download times (B)	% of immediacy download times (B/A)	Increase rate of immediacy download times	Avg. immediacy download ratio
2016	271 828 764	26 331 640	9.69	—	29.80
2017	272 863 685	29 386 539	10.77	11.60	32.80
2018	306 172 698	42 700 698	13.95	45.31	41.61
2019	381 620 883	62 218 112	16.30	45.71	65.28
2020	411 105 332	88 677 107	21.57	42.53	88.86

Note: The data source is the *Impact Factor Annual Report* 2017–2021 editions.
The statistical scope is STM journals indexed by CNKI and reported in the *Impact Factor Annual Report*.
The increase rate is the year-on-year increase rate of immediacy downloads.

2.1.2.6 Distribution by Journal Discipline

Analyzing the discipline categories of the 3516 Chinese language STM journals included in the *Annual Report for Chinese Academic Journals Impact Factors* 2021 edition, there are the following findings. The discipline with the largest number of journals is "natural science and engineering technology" (259 titles). 96 390 articles make "medicine and health" the discipline with the largest amount of citable articles. Journals of "physical geography" enjoy the highest average web immediacy download ratio per journal, which is 314.50 articles. Journals in the discipline of "traditional Chinese medicine and herbalism" have the highest composite total number of citations, which is 495 700 times. Journals of "physical geography" enjoy the highest average composite total citations per journal (7931.08 times). Journals of the same discipline also crown in terms of the highest composite impact factor (3.650) and the highest composite immediacy index (0.495). The journals "geophysics" have the longest cited half-life period (8.43 years), and correspondingly journals of "nursing" enjoy the shortest cited half-life period, which is 3.43 years. Statistics show that "physical geography" has the highest web immediacy download ratio, composite total times cited per journal, composite impact factor, and average composite immediacy index (table 2.14).

According to the *International Citation Annual Report* 2021 edition, there are 116 Chinese language STM journals selected as TOP journals of international influence, distributed in 39 disciplines, and the discipline with the most journals selected is "geology" (20 journals). The discipline with the highest total number of international citations (excluding self-citations) is "geology" (44 170 times cited). The discipline with the highest total number of international citations (excluding self-citations) per journal is "agricultural engineering" (3742 times cited). The discipline with the highest average impact factor per journal is "chemistry" (1.037). The discipline with the highest immediacy index per journal is "obstetrics, gynecology & pediatrics" (1.902) (table 2.15).

2.1.2.7 Analysis of International Impact of Chinese Language STM Journals

WJCI 2021 covers a total of 1218 Chinese language STM journals. Among them, the World Journal Clout Index (WJCI) rank of 114 journals in the first quartile (Q1) by discipline accounts for 9.36% of all selected Chinese language STM journals. The numbers and the quartiles of Chinese language STM journals in different disciplines are shown in table 2.16.

2.2 Impact Analysis of China's English Language STM Journals

2.2.1 Launching of English STM Journals in China in 2021

According to the annual review data of journals, 41 English language journals were launched in China in 2021[1]. The disciplines with the largest number of new English

TAB. 2.14 – Distribution by discipline of domestic impact of Chinese language STM journals in 2020.

No.	Discipline	No. of journals	No. of citable articles	Avg. immediacy download ratio	Composite total times cited	Composite total times cited per journal	Avg. IF	Composite immediacy index	Avg. citation half-life period (in yr)
1	Natural Science & Engineering Technology in General	259	47 691	98.33	229 765	887.12	0.586	0.108	5.25
2	Medicine & Health in General	183	96 390	77.78	331 877	1813.54	0.599	0.166	3.59
3	Chemical Engineering	172	44 483	72.18	207 373	1205.66	0.546	0.082	6.17
4	Civil Engineering	162	49 056	96.25	388 491	2398.09	0.714	0.107	5.14
5	Transportation Engineering	146	34 092	67.34	191 552	1312.00	0.648	0.100	5.21
6	Radio Electronics, Telecommunications	144	42 277	87.49	232 203	1612.52	0.826	0.132	4.46
7	Automation Technology, Computer Technology	126	51 301	119.54	382 237	3033.63	1.180	0.190	4.23
8	Engineering Technology in General	123	24 308	105.77	228 319	1856.25	0.873	0.131	5.83
9	Electrical Engineering	119	30 149	81.57	337 687	2837.71	1.144	0.182	4.47
10	Traditional Chinese Medicine & Herbalism	118	54 272	142.39	495 749	4201.26	1.130	0.313	4.42
11	Clinical Medicine in General	110	67 102	78.03	258 012	2345.56	0.860	0.186	3.54
12	Agricultural Science in General	96	35 323	101.14	302 490	3150.94	1.008	0.135	6.37
13	Geology	96	11 794	90.27	327 593	3412.43	1.661	0.326	8.09
14	Internal Medicine	95	23 214	72.84	187 688	1975.66	1.114	0.275	3.77
15	Oil & Gas Industry	89	17 978	66.69	179 357	2015.25	1.167	0.169	6.27
16	Metallurgical Engineering Technology	82	16 712	50.72	78 807	961.06	0.592	0.094	6.55
17	Mechanical Engineering	82	31 118	66.95	172 495	2103.60	0.679	0.094	5.30
18	Metal Science & Metalwork	78	16 039	66.65	142 426	1825.97	0.731	0.116	6.30
19	Preventive Medicine & Hygiene	76	26 632	82.25	174 590	2297.24	1.076	0.259	3.81
20	Surgery	76	17 805	53.48	116 940	1538.68	0.988	0.155	3.61
21	Hydraulic Engineering	74	17 660	64.62	111 848	1511.46	0.740	0.131	5.13
22	Mining Engineering Technology	73	18 790	62.84	166 330	2278.49	0.904	0.187	5.52
23	Animal Husbandry, Veterinary Science	68	17 534	74.96	118 081	1736.49	0.741	0.114	5.42

Tab. 2.14 – (continued).

24	Biology	66	11 931	162.52	238 166	3608.58	1.301	0.278	7.27
25	Environmental Science & Technology	64	15 997	148.83	250 005	3906.33	1.494	0.215	5.41
26	Forestry	64	8852	84.14	114 215	1784.61	0.983	0.167	6.50
27	Pharmacy	59	24 683	117.78	134 637	2281.98	0.882	0.202	4.39
28	Basic Medicine	56	11 968	95.50	75 646	1350.82	0.825	0.177	3.90
29	Aeronautical and Space Science & Technology	53	6582	75.04	75 889	1431.87	0.696	0.101	6.29
30	Energy & Power Engineering	51	11 525	71.16	56 769	1113.12	0.692	0.095	5.18
31	Food Science & Technology	50	19 933	121.22	211 876	4237.52	1.214	0.197	5.18
32	Engineering & Technology Science Basic Disciplines	49	9590	98.84	81 284	1658.86	0.825	0.113	5.61
33	Agronomy	47	9604	89.81	99 778	2122.94	1.249	0.200	6.49
34	Chemistry	39	7035	113.56	82 968	2127.38	1.001	0.176	5.90
35	Textile Science & Technology	36	6262	79.75	27 414	761.50	0.534	0.103	4.71
36	Physics	34	7607	84.82	81 824	2406.59	0.902	0.158	5.72
37	Oncology	34	7902	86.16	53 350	1569.12	1.196	0.156	3.72
38	Obstetrics, Gynecology, & Pediatrics	31	8398	90.54	79 426	2562.13	1.187	0.263	3.85
39	Atmospheric Science	30	2530	71.57	55 250	1841.67	1.421	0.214	7.10
40	Neurology & Psychiatry	30	5878	59.92	41 788	1392.93	0.837	0.124	4.12
41	Light Industry (Excl Textile & Food)	28	8291	72.07	27 056	966.29	0.760	0.204	5.21
42	Medicine & Health Administration	27	12 163	108.32	55 483	2054.93	1.112	0.200	3.52
43	Geophysics	27	3137	69.70	81 588	3021.78	1.157	0.184	8.43
44	Surveying and Mapping Science & Technology	27	5258	107.22	67 118	2485.85	1.267	0.163	4.58
45	Weapon Industry & Military Technology	26	4002	96.73	34 568	1329.54	0.772	0.115	5.73
46	Mathematics	25	2707	94.56	20 405	816.20	0.514	0.175	7.63
47	Aquaculture	24	3250	101.96	38 541	1605.88	1.029	0.137	7.13
48	Otorhinolaryngology and Ophthalmology	23	3931	49.35	28 131	1223.09	0.801	0.129	4.17
49	Nursing	23	14 402	111.95	97 295	4230.22	1.082	0.171	3.43
50	Marine Sciences	22	2347	92.95	36 624	1664.73	0.921	0.099	8.36
51	Material Sciences	22	5372	125.09	70 581	3208.23	0.904	0.146	6.60

Tab. 2.14 – (continued).

No.	Discipline	No. of journals	No. of citable articles	Avg. immediacy download ratio	Composite total times cited	Composite total times cited per journal	Avg. IF	Composite immediacy index	Avg. citation half-life period (in yr)
52	Horticulture	22	4851	90.18	54 366	2471.18	1.111	0.201	6.04
53	Plant Protection	21	3349	90.81	39 641	1887.67	1.265	0.205	6.45
54	Agricultural Basic Science	20	3789	147.40	133 775	6688.75	2.253	0.328	6.55
55	Agricultural Engineering	19	10 948	89.58	94 399	4968.37	0.980	0.146	4.77
56	Stomatology	18	2174	68.25	13 524	751.33	0.717	0.128	4.05
57	Military Medicine & Special Medicine	17	3355	62.82	26 316	1548.00	0.986	0.444	4.06
58	Safety Science & Technology	17	2852	76.24	35 708	2100.47	0.960	0.122	5.64
59	Mechanics	15	1950	95.00	34 506	2300.40	1.142	0.176	6.66
60	Nuclear Science & Technology	14	1700	47.00	9894	706.71	0.442	0.081	7.26
61	Resource Science	12	2070	208.67	50 102	4175.17	1.829	0.375	5.47
62	Physical Geography	12	1591	314.50	95 173	7931.08	3.650	0.495	7.54
63	Dermatology & Venereology	7	1901	73.14	10 261	1465.86	0.625	0.068	4.40
64	Systems Science	6	753	212.83	27 887	4647.83	1.768	0.158	5.85
65	Astronomy	5	337	53.40	2824	564.80	0.642	0.222	6.66
	Total	3516	972 803	88.47	7 465 672	2123.34	0.802	0.145	4.29

Note: The data source is the *Annual Report for Chinese Academic Journals Impact Factors* 2021.
There are journals that belong to two or more disciplines. The total data is after deduplication.

Tab. 2.15 – Data on international impact of TOP Chinese language STM journals in each discipline in 2020.

No.	Discipline	No. of journals	Int'l total citations (w/o self-cites)	Int'l total citations per journal (w/o self-cites)	Avg. IF	Avg. immediacy index
1	Geology	20	44 170	2208.50	0.621	0.141
2	Chemistry	10	19 244	1924.40	1.037	0.338
3	Biology	7	14 816	2116.57	0.478	0.124
4	Radio Electronics, Telecommunications Technology	7	11 159	1594.14	0.532	0.105
5	Automation Technology, Computer Technology	7	9185	1312.14	0.421	0.071
6	Physics	6	14 937	2489.50	0.602	0.128
7	Electrical Engineering	6	14 475	2412.50	0.399	0.042
8	Civil Engineering	5	17 055	3411.00	0.562	0.089
9	Oil & Gas Industry	5	10 256	2051.20	1.023	0.179
10	Environmental Science & Technology	5	9071	1814.20	0.349	0.035
11	Mining Engineering Technology	4	8782	2195.50	0.660	0.129
12	Physical Geography	4	7392	1848.00	0.698	0.075
13	Geophysics	4	7258	1814.50	0.417	0.089
14	Material Sciences	4	6480	1620.00	0.400	0.108
15	Traditional Chinese Medicine & Herbalism	3	8193	2731.00	0.307	0.164
16	Metal Science & Metalwork	3	6253	2084.33	0.526	0.206
17	Chemical Engineering	3	3880	1293.33	0.819	0.110
18	Agricultural Engineering	2	7484	3742.00	0.361	0.028
19	Agricultural Basic Science	2	3809	1904.50	0.330	0.058
20	Preventive Medicine & Hygiene	2	3775	1887.50	0.456	1.393
21	Metallurgical Engineering Technology	2	3462	1731.00	0.631	0.296
22	Medicine & Health Comprehensive	2	3344	1672.00	0.264	0.222
23	Resource Science	2	3056	1528.00	0.452	0.095
24	Atmospheric Science	2	2630	1315.00	0.561	0.100
25	Obstetrics, Gynecology, and Pediatrics	2	2480	1240.00	0.326	1.902
26	Hydraulic Engineering	2	2297	1148.50	0.437	0.045
27	Internal Medicine	2	2025	1012.50	0.314	1.438

Tab. 2.15 – (continued).

No.	Discipline	No. of journals	Int'l total citations (w/o self-cites)	Int'l total citations per journal (w/o self-cites)	Avg. IF	Avg. immediacy index
28	Surveying and Mapping Science & Technology	2	1818	909.00	0.539	0.069
29	Mechanical Engineering	1	2787	2787.00	0.316	0.031
30	Agricultural Science in General	1	2234	2234.00	0.255	0.014
31	Natural Science & Engineering Technology in General	1	2204	2204.00	0.737	0.113
32	Pharmacy	1	1744	1744.00	0.224	0.082
33	Agronomy	1	1556	1556.00	0.305	0.022
34	Engineering Technology in General	1	1420	1420.00	0.224	0.025
35	Systems Science	1	1418	1418.00	0.248	0.028
36	Oncology	1	1099	1099.00	1.021	0.704
37	Forestry	1	1089	1089.00	0.248	0.028
38	Transportation Engineering	1	1081	1081.00	0.445	0.091
39	Plant Protection	1	1054	1054.00	0.226	0.025
	Total	116	227 540	1961.55	0.473	0.167

Note: Data sources are the *International Citation Annual Report* 2021 edition.
There are journals that belong to two or more disciplines. The total data is after deduplication.

Tab. 2.16 – The number of Chinese language STM journals in *WJCI* 2021.

No.	Discipline	No. of journals	No. of journals in each quartile			
			Q1	Q2	Q3	Q4
1	Clinical Medicine	135	1	7	25	102
2	Earth Sciences	96	17	22	38	19
3	Agronomy	74	14	30	18	12
4	Science & Technology in General	52	7	19	21	5
5	Biology	45	1	4	15	25
6	Mining Engineering Technology	45	10	18	11	6
7	Chemical Engineering	42	0	2	19	21
8	Electronics, Telecommunications	40	2	10	15	13
9	Computer Science and Technology	36	11	7	14	4
10	Material Sciences	35	1	4	14	16
11	Power and Electrical Engineering	34	5	5	13	11
12	Transportation Engineering	34	1	10	15	8

Tab. 2.16 – (continued).

No.	Discipline	No. of journals	No. of journals in each quartile			
			Q1	Q2	Q3	Q4
13	Civil Engineering	32	4	6	13	9
14	Engineering General Technology and Basic Disciplines	31	5	11	10	5
15	Aviation, Aerospace Science and Technology	31	3	7	14	7
16	Preventive Medicine and Public Health	29	1	4	13	11
17	Engineering in General	29	13	11	5	0
18	Mechanical Engineering	29	1	4	17	7
19	Chemistry	26	0	2	12	12
20	Medicine in General	24	1	4	16	3
21	Environmental and Resource Science and Technology	24	2	6	6	10
22	Basic Medicine	23	0	1	6	16
23	Hydraulic Engineering	20	2	5	8	5
24	Forestry	19	2	8	7	2
25	Animal Husbandry, Veterinary Science	19	0	4	8	7
26	Pharmacy	18	0	6	3	9
27	Energy Science and Technology	17	0	5	8	4
28	Physics	15	0	2	6	7
29	Natural Science & Engineering Technology in General	15	2	2	2	9
30	Food Science and Technology	15	1	3	8	3
31	Traditional Chinese Medicine & Herbalism	14	3	0	5	6
32	Metallurgical Engineering Technology	14	1	5	7	1
33	Information and Systems Science Related Engineering and Technology	13	2	2	7	2
34	Mathematics	12	0	0	3	9
35	Mechanics	11	0	2	4	5
36	Aquaculture	11	0	0	8	3
37	Surveying and Mapping Science & Technology	10	0	3	4	3
38	Nuclear Science and Technology	1	0	0	3	7
39	Textile Science and Technology	10	1	0	5	4
40	Safety Science and Technology	9	0	1	7	1
41	Special Medicine & Forensic Medicine	6	0	1	4	1
42	Astronomy	5	0	1	3	1
43	Instrumentation Technology	4	0	2	1	1
44	Information Science and Systems Science	3	0	0	2	1
45	Psychology	2	0	1	1	0
	Total	1218	114	247	444	413

Note: Listed in descending order of the number of Chinese journals indexed.
The data source is WJCI Report 2021.
In cases where a journal spans multiple disciplines, the discipline with the highest-ranking percentile is used.

language journals are medicine and health (12 titles), agricultural science (4), automation technology, computer technology (3), environmental science, and safety science (3). The list of newly launched English language journals in China in 2021 is shown in table 2.17.

TAB. 2.17 – List of newly launched English language STM journals in China in 2021.

No.	Title (ENG)	Title (CHN)	CN No.	Hosting organization
1	*Grassland Research*	草地研究	10-1777/S	Chinese Grassland Society and Lanzhou University
2	*Infectious Disease Modelling*	传染病建模	10-1766/R	China Science Publishing & Media Ltd.
3	*Magnetic Resonance Letters*	磁共振快报	42-1917/O4	Innovation Academy for Precision Measurement Science and Technology, CAS
4	*eScience*	电化学与能源科学	12-1468/O6	Nankai University
5	*Biomimetic Intelligence and Robotics*	仿生智能与机器人	37-1527/TP	Shandong University
6	*Radiation Medicine and Protection*	放射医学与防护	10-1773/R	Chinese Medical Association
7	*Waste Disposal & Sustainable Energy*	废弃物处置与可持续能源	33-1423/TK	Zhejiang University
8	*Gynecology and Obstetrics Clinical Medicine, GOCM*	妇产科临床医学	10-1763/R	Peking University
9	*Infectious Medicine*	感染医学	10-1774/R	Tsinghua University
10	*Opto-Electronic Science* (*OES*)	光电科学	51-1800/O4	Institute of Optics and Electronics, CAS
11	*iLiver*	国际肝胆健康	10-1764/R	Tsinghua University
12	*National Science Open*	国家科学进展	10-1767/N	China Science Publishing & Media Ltd.
13	*Synthetic and Systems Biotechnology*	合成和系统生物技术	10-1776/Q	China Science Publishing & Media Ltd.
14	*ChemPhysMater*	化学物理材料	37-1531/O	Shandong University
15	*Emergency and Critical Care Medicine*	急危重症医学	37-1533/R	Shandong University
16	*Health Data Science*	健康数据科学	10-1749/R	Peking University
17	*Space*: *Science & Technology*	空间科学与技术	10-1811/V	Beijing Institute of Technology
18	*Cyborg and Bionic Systems*	类生命系统	10-1778/TP	Beijing Institute of Technology

Tab. 2.17 – (continued).

No.	Title (ENG)	Title (CHN)	CN No.	Hosting organization
19	*Energy Material Advances*	能源材料前沿	10-1792/T	Beijing Institute of Technology
20	*Artificial Intelligence in Agriculture*	农业人工智能	10-1795/S	China Science Publishing & Media Ltd.
21	*Information Processing in Agriculture*	农业信息处理	10-1751/S	China Agricultural University, China Science Publishing & Media Ltd.
22	*Laparoscopic, Endoscopic and Robotic Surgery Quarterly*	腔镜、内镜与机器人外科	33-1421/R	Zhejiang University
23	*Regional Sustainability*	区域可持续发展	65-1317/X	Xinjiang Institute of Ecology and Geography, CAS
24	*Deep Underground Science and Engineering*	深地科学	32-1897/P	China University of Mining and Technology
25	*Ecological Processes*	生态过程	21-1614/X	Shenyang Institute of Applied Ecology, CAS
26	*Journal of Biosafety and Biosecurity*	生物安全和生物安保	10-1796/Q	China Science Publishing & Media Ltd.
27	*Bioactive Materials*	生物活性材料	10-1775/Q	China Science Publishing & Media Ltd.
28	*Biochar*	生物炭	21-1615/S	Shenyang Agricultural University
29	*Food Science and Human Wellness*	食品科学与人类健康	10-1750/TS	Beijing Academy of Food Science
30	*Communications in Mathematics and Statistics*	数学与统计通讯	34-1335/O1	University of Science and Technology of China
31	*Unmanned Systems*	无人系统	10-1779/TP	Beijing Institute of Technology
32	*Green Energy and Intelligent Transportation*	新能源与智能载运	10-1812/U	Beijing Institute of Technology
33	*Emerging Contaminants*	新兴污染物	10-1794/X	China Science Publishing & Media Ltd.
34	*InfoMat*	信息材料	51-1799/TB	University of Electronic Science and Technology of China
35	*Medical Review*	医学评论	10-1793/R	Peking University

Tab. 2.17 – (continued).

No.	Title (ENG)	Title (CHN)	CN No.	Hosting organization
36	*Regenerative Biomaterials*	再生生物材料	51-1798/R	Chinese Society for Biomaterials
37	*Acupuncture and Herbal Medicine*	针灸和草药	12-1467/R	Tianjin University of Traditional Chinese Medicine, China Association of Chinese Medicine
38	*Plant Phenomics*	植物表型组学	32-1898/Q	Nanjing Agricultural University
39	*AI in Civil Engineering*	智能建造	31-2183/TU	Tongji University
40	*Chinese Journal of Mechanical Engineering: Additive Manufacturing Frontiers*	中国机械工程学报: 增材制造前沿	10-1752/TH	Chinese Mechanical Engineering Society
41	*Journal of Intensive Medicine*	重症医学	10-1765/R	Chinese Medical Association

2.2.2 Papers Published in China's English Language STM Journals

Taking the 383 Chinese English language STM journals indexed by CNKI as the statistical scope (*i.e.*, the "English language STM journals" in this part), we statistically analyze the number of papers, discipline distribution, institution distribution, funded papers, international collaboration, etc. of China's English language STM journals in 2020.

2.2.2.1 Distribution of English Language STM Journals in China by Discipline

In 2020, 32 914 citable articles were published in 383 English language journals, of which 696 articles were in social sciences or cross-social sciences areas, and the remaining 32 218 papers were distributed in 60 science and technology disciplines (please see the 60 disciplines in the *Annual Report for Chinese Academic Journals Impact Factors*). Some articles may cover two or more disciplines, so after considering the disciplinary re-scoring, the total number of English articles in the various disciplines of science and technology was counted to be 38 235, and the number and percentage of English articles in each discipline are shown in table 2.18. Among the disciplines, there were 23 disciplines with more than 500 papers each, and these 23 disciplines accounted for 80.81% of the total number of papers. The top five disciplines in terms of the number of papers are "materials science" (2540 papers, or 6.64%), "chemical engineering" (2305 papers, or 6.03%), "automation technology, computer technology" (2291 papers, accounting or 5.99%), "chemistry" (2186 articles, or 5.72%) and "electrical engineering" (1972 articles, or 5.16%).

Tab. 2.18 – Number of papers in China's English language journals in various disciplines in 2020.

No.	Disciplines	Number of papers	Percentage
1	Materials Science	2540	6.64
2	Chemical Engineering	2305	6.03
3	Automation Technology, Computer Technology	2291	5.99
4	Chemistry	2186	5.72
5	Electrical Engineering	1972	5.16
6	Radio Electronics, Telecommunications Technology	1860	4.86
7	Biology	1853	4.85
8	Physics	1694	4.43
9	Environmental Science & Technology	1650	4.32
10	Metal Science & Metalwork	1453	3.80
11	Mathematics	1393	3.64
12	Internal Medicine	1368	3.58
13	Oncology	1189	3.11
14	Traditional Chinese Medicine & Herbalism	926	2.42
15	Geology	905	2.37
16	Transportation Engineering	881	2.30
17	Basic Medicine	810	2.12
18	Neurology & Psychiatry	711	1.86
19	Civil Engineering	657	1.72
20	Aeronautical and Astronautical Science & Technology	636	1.66
21	Surgery	577	1.51
22	Atmospheric Science	528	1.38
23	Agronomy	514	1.34
24	Marine Science	467	1.22
25	Pharmacology	428	1.12
26	Oil & Gas Industry	381	1.00
27	Preventive Medicine & Hygiene	379	0.99
28	Forestry	373	0.98
29	Astronomy	368	0.96
30	Mechanic Engineering	333	0.87
31	Animal Husbandry & Veterinary Medicine	327	0.86
32	Mechanics	297	0.78
33	Plant Protection	291	0.76
34	Energy and Power Engineering	273	0.71
35	Geophysics	268	0.70
36	Horticulture	257	0.67
37	Agricultural Basic Sciences	247	0.65
38	Metallurgical Engineering Technology	243	0.64
39	Obstetrics, Gynecology & Pediatrics	227	0.59
40	Mining Engineering Technology	227	0.59
41	Clinical Medicine in General	210	0.55

Tab. 2.18 – (continued).

No.	Disciplines	Number of papers	Percentage
42	Nuclear Science & Technology	185	0.48
43	Otorhinolaryngology & Ophthalmology	156	0.41
44	Hydraulic Engineering	152	0.40
45	Food Science and Technology	139	0.36
46	Basic Disciplines of Engineering and Technology Science	131	0.34
47	Aquaculture	128	0.33
48	Surveying and Mapping Science & Technology	124	0.32
49	Agricultural Engineering	87	0.23
50	Physical Geography	85	0.22
51	Dermatology & Venereology	82	0.21
52	Weapon Industry & Military Technology	78	0.20
53	Health & Medicine Administration	77	0.20
54	Nursing	76	0.20
55	Stomatology	72	0.19
56	Light Industry (Excl Textile & Food)	66	0.17
57	Military Medicine & Special Medicine	46	0.12
58	Textile Science & Technology	26	0.07
59	Systems Science	18	0.05
60	Safety Science & Technology	12	0.03
	Total	38 235	100.00

Note: Listed in descending order of the number of papers published.
The data is from CNKI.
There is overlap between disciplines, *i.e.*, a paper may cover 2 or more disciplines.

2.2.2.2 Regional Distribution of English Language STM Journals in China

The statistical results of all regions where Chinese publishing institutions are located (excluding Hong Kong, Macao, and Taiwan) show (table 2.19) that in 2020, the three regions with the highest number of papers published in English language STM journals were Beijing (8806, accounting for 22.56%), Shanghai (3230, 8.27%), and Jiangsu (3196, 8.19%).

2.2.2.3 Distribution of English Language STM Journals by Publishing Institutions

In 2020, the institutions publishing English language STM journals were led by higher education institutions, with 27 500 papers, accounting for 61.26% of all articles published in the English language STM journals; research institutions with 8600 papers, accounting for 19.21%; medical institutions with 4700 papers, accounting for 10.47%; enterprises with a relatively small number, only 1700, accounting for 3.73%; and other types of institution with 2400 articles, accounting for 5.34% (figure 2.2).

Tab. 2.19 – Number of papers published in China's English language STM journals in 2020 (by region, excluding Hong Kong, Macao and Taiwan).

No.	Region	No. of papers	Percentage	No.	Region	No. of papers	Percentage
1	Beijing	8806	22.56	17	Jilin	669	1.71
2	Shanghai	3230	8.27	18	Chongqing	642	1.64
3	Jiangsu	3196	8.19	19	Hebei	599	1.53
4	Guangdong	2405	6.16	20	Gansu	581	1.49
5	Hubei	1937	4.96	21	Yunnan	491	1.26
6	Shandong	1892	4.85	22	Shanxi	434	1.11
7	Zhejiang	1761	4.51	23	Jiangxi	407	1.04
8	Shaanxi	1646	4.22	24	Guangxi	321	0.82
9	Sichuan	1480	3.79	25	Xinjiang	309	0.79
10	Hunan	1331	3.41	26	Guizhou	239	0.61
11	Liaoning	1307	3.35	27	Inner Mongolia	205	0.53
12	Anhui	1153	2.95	28	Hainan	151	0.39
13	Tianjin	1082	2.77	29	Qinghai	77	0.20
14	Henan	993	2.54	30	Ningxia	60	0.15
15	Heilongjiang	850	2.18	31	Tibet	34	0.09
16	Fujian	752	1.93		Total	39 040	100.00

Note: Listed in descending order according to number of published papers.
The data comes from CNKI.
Cross-regional collaborative papers are counted across multiple regions.

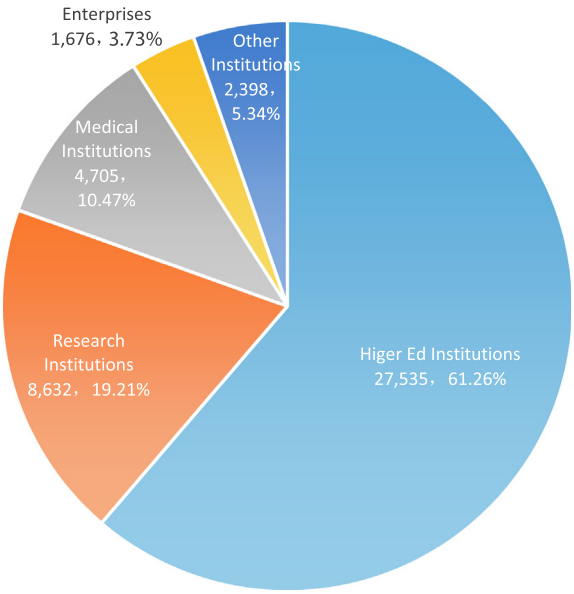

Fig. 2.2 – Distribution of Publishing Institutions of China's English Language STM Journals in 2020.

Table 2.20 lists the composition of types of institutions that publish articles in English language STM journals by discipline:

1) There are eight disciplines in which the proportion of papers published by higher education institutions exceeds 95%, among which "textile science and technology," "systems science," and "safety science and technology" participated in the publication of all papers (with a publication rate of 100%). The remaining five disciplines with a proportion of more than 95% are "mechanics" (98.99%), "mathematics" (97.91%), "weapons industry and military technology" (97.44%), "materials science" (96.02%), and "chemistry" (95.24%).
2) The top ten disciplines in which research institutions have a relatively high proportion of paper publications are "nuclear science and technology" (71.89%), "astronomy" (58.42%), "atmospheric science" (54.73%), "agronomy" (51.07%), "aquaculture" (50.00%), "geophysics" (48.51%), "marine sciences" (48.18%), "plant protection" (46.05%), "geology" (45.41%), and "basic agricultural sciences" (44.53%).
3) Medical institutions mainly focus on different fields of clinical medicine. The top ten disciplines with a relatively high proportion of paper publications are "obstetrics, gynecology and pediatrics" (80.62%), "dermatology and venereology" (80.49%), "internal medicine" (74.28%), "oncology" (70.79%), "surgery" (70.66%), "stomatology" (68.06%), "otorhinolaryngology and ophthalmology" (64.74%), "medicine and health management" (61.04%), "general clinical medicine" (60.58%), and "neurology and psychiatry" (58.03%).
4) Enterprises have relatively few publications in English-language STM journals. There are eight disciplines with a share of more than 10%, namely "oil and gas industry" (28.42%), "transportation engineering" (27.24%), "safety science and technology" (16.67%), "geology" (15.91%), "metallurgical engineering technology" (15.64%), "weapons industry and military technology" (11.54%), "mining engineering technology" (11.45%), and "metallurgy and metalworking" (10.81%).

2.2.2.4 Analysis of Funded Papers in English Language STM Journals

In 2020, a total of 26 850 papers supported by various funds were published in China's English language STM journals, accounting for 81.58% of the total number of 32 914 papers in English language STM journals. The top ten research funders with the largest number of funded papers are listed in table 2.21. It can be seen that in addition to national funds such as the National Natural Science Foundation of China (NSFC) and the National Key Research and Development Program (NKRDP), provincial funds in Jiangsu, Beijing, and Guangdong are also more heavily resourced.

Table 2.22 shows the number and percentage of funded papers published by China's English language STM journals in various disciplines in 2020. "Horticulture" (97.67%), "aquaculture" (96.09%), "agronomy" (95.91%), "chemistry" (95.56%), "plant protection" (94.50%), "metallurgical engineering technology" (93.00%), "geology" (91.49%), "animal husbandry, veterinary science" (90.83%), and "astronomy" (90.76%).

TAB. 2.20 – The distribution of publishing institutions of China's English language STM journals in 2020.

No.	Disciplines	Total no. of papers	Higher ed. inst		Research inst		Medical inst		Enterprises		Others	
			No. of papers	%	No. of papers	%	No. of papers	%	No. of papers	/%	No. of papers	%
1	Materials Science	2540	2439	96.02	573	22.56	112	4.41	90	3.54	122	4.80
2	Chemical Engineering	2304	2153	93.45	519	22.53	60	2.60	118	5.12	93	4.04
3	Automation Technology, Computer Technology	2288	2167	94.71	478	20.89	87	3.80	136	5.94	104	4.55
4	Chemistry	2186	2082	95.24	555	25.39	62	2.84	52	2.38	77	3.52
5	Electrical Engineering	1969	1857	94.31	550	27.93	6	0.30	159	8.08	109	5.54
6	Radio Electronics Telecommunications	1859	1724	92.74	480	25.82	8	0.43	113	6.08	86	4.63
7	Biology	1849	1569	84.86	711	38.45	203	10.98	27	1.46	230	12.44
8	Physics	1692	1600	94.56	500	29.55	18	1.06	21	1.24	75	4.43
9	Environmental Science and Technology	1637	1481	90.47	483	29.51	31	1.89	61	3.73	211	12.89
10	Metal Science and Metalwork	1453	1349	92.84	384	26.43	22	1.51	157	10.81	41	2.82
11	Mathematics	1389	1360	97.91	112	8.06	6	0.43	12	0.86	59	4.25
12	Internal Medicine	1357	648	47.75	205	15.11	1008	74.28	16	1.18	78	5.75
13	Oncology	1188	693	58.33	171	14.39	841	70.79	10	0.84	30	2.53
14	Traditional Chinese Medicine & Pharmacology	925	654	70.70	193	20.86	468	50.59	36	3.89	40	4.32
15	Geology	905	758	83.76	411	45.41	0	0.00	144	15.91	157	17.35
16	Transportation Engineering	881	729	82.75	152	17.25	0	0.00	240	27.24	60	6.81
17	Basic Medicine	808	683	84.53	222	27.48	289	35.77	10	1.24	33	4.08
18	Neurology and Psychiatry	710	493	69.44	113	15.92	412	58.03	4	0.56	22	3.10
19	Civil Engineering	657	612	93.15	97	14.76	11	1.67	46	7.00	22	3.35
20	Aeronautical, Astronautical Science & Technology	636	570	89.62	212	33.33	0	0.00	44	6.92	34	5.35
21	Surgery	576	265	46.01	47	8.16	407	70.66	4	0.69	32	5.56
22	Atmospheric Science	528	327	61.93	289	54.73	4	0.76	8	1.52	221	41.86
23	Agronomy	513	428	83.43	262	51.07	4	0.78	14	2.73	56	10.92
24	Marine Sciences	467	376	80.51	225	48.18	0	0.00	14	3.00	84	17.99
25	Pharmacy	428	351	82.01	87	20.33	152	35.51	22	5.14	19	4.44

Tab. 2.20 – (continued).

No.	Disciplines	Total no. of papers	Higher ed. inst		Research inst		Medical inst		Enterprises		Others	
			No. of papers	%	No. of papers	%	No. of papers	%	No. of papers	/%	No. of papers	%
26	Oil & Gas Industry	380	304	80.00	109	28.68	0	0.00	108	28.42	16	4.21
27	Preventive Medicine & Hygiene	376	251	66.76	69	18.35	165	43.88	4	1.06	46	12.23
28	Forestry	373	317	84.99	115	30.83	2	0.54	2	0.54	59	15.82
29	Astronomy	368	298	80.98	215	58.42	0	0.00	4	1.09	25	6.79
30	Mechanical Engineering	333	308	92.49	73	21.92	5	1.50	21	6.31	18	5.41
31	Animal Husbandry, Veterinary Science	326	297	91.10	126	38.65	12	3.68	25	7.67	21	6.44
32	Mechanics	297	294	98.99	37	12.46	0	0.00	5	1.68	3	1.01
33	Plant Protection	291	253	86.94	134	46.05	4	1.37	5	1.72	20	6.87
34	Energy & Power Engineering	273	251	91.94	66	24.18	0	0.00	20	7.33	26	9.52
35	Geophysics	268	210	78.36	130	48.51	0	0.00	3	1.12	55	20.52
36	Horticulture	257	225	87.55	101	39.30	1	0.39	8	3.11	23	8.95
37	Agricultural Basic Sciences	247	209	84.62	110	44.53	1	0.40	4	1.62	34	13.77
38	Metallurgical Engineering	243	227	93.42	36	14.81	2	0.82	38	15.64	18	7.41
39	Mining Engineering Technology	227	203	89.43	37	16.30	0	0.00	26	11.45	17	7.49
40	Obstetrics, Gynecology, & Pediatrics	227	93	40.97	21	9.25	183	80.62	2	0.88	8	3.52
41	General Clinical Medi	208	135	64.90	34	16.35	126	60.58	3	1.44	10	4.81
42	Nuclear Science & Technology	185	133	71.89	133	71.89	2	1.08	6	3.24	13	7.03
43	Otorhinolaryngology & Ophthalmology	156	101	64.74	10	6.41	101	64.74	0	0.00	7	4.49
44	Hydraulic Engineering	152	130	85.53	55	36.18	0	0.00	10	6.58	15	9.87
45	Food Science & Technology	139	129	92.81	33	23.74	4	2.88	5	3.60	10	7.19
46	Basic Disciplines of Engineering & Technology Science	131	121	92.37	31	23.66	1	0.76	8	6.11	0	0.00
47	Aquaculture	128	107	83.59	64	50.00	3	2.34	8	6.25	14	10.94

Tab. 2.20 – (continued).

48	Surveying and Mapping Science & Technology	124	95	76.61	38	30.65	0	0.00	8	6.45	22	17.74
49	Agricultural Engineering	87	77	88.51	11	12.64	0	0.00	3	3.45	27	31.03
50	Physical Geography	85	77	90.59	35	41.18	0	0.00	1	1.18	9	10.59
51	Dermatology & Venereology	82	20	24.39	15	18.29	66	80.49	3	3.66	9	10.98
52	Weapons Industry & Military Technology	78	76	97.44	14	17.95	0	0.00	9	11.54	7	8.97
53	Medicine & Health Administration	77	49	63.64	5	6.49	47	61.04	0	0.00	6	7.79
54	Nursing	75	51	68.00	1	1.33	42	56.00	0	0.00	9	12.00
55	Stomatology	72	41	56.94	5	6.94	49	68.06	0	0.00	4	5.56
56	Light Industry (excl textile & food)	66	62	93.94	8	12.12	0	0.00	3	4.55	7	10.61
57	Military Medicine & Special Medicine	46	26	56.52	8	17.39	24	52.17	0	0.00	2	4.35
58	Textile Science & Technology	26	26	100.00	3	11.54	1	3.85	1	3.85	0	0.00
59	Systems Science	18	18	100.00	2	11.11	0	0.00	0	0.00	1	5.56
60	Safety Science & Technology	12	12	100.00	3	25.00	0	0.00	2	16.67	2	16.67
	Total	38 178	32 594	85.37	9918	25.98	5052	13.23	1903	4.98	2658	6.96

Note: The papers are listed in descending order according to the number of papers in the discipline.
The number of papers in disciplines in this table is the number of papers from authorship institutions in each discipline.
The data source is CNKI.
"Percentage" refers to the proportion of the number of papers published by this type of institution to the total number of papers in this discipline.
The table is based on the statistical results of all the publishing institutions of a single paper a paper that crosses several disciplines or is completed through the cooperation of several types of institutions is counted separately.

Tab. 2.21 – Major funding for papers published in China's English language STM journals in 2020 (Top ten funds).

No.	Fund name	No. of papers
1	National Natural Science Foundation of China	17 289
2	National Key Research and Development Program	3303
3	China Postdoctoral Science Foundation	1122
4	Jiangsu Natural Science Foundation	589
5	Beijing Municipal Natural Science Foundation	460
6	Guangdong Natural Science Foundation	408
7	Shandong Natural Science Foundation	365
8	China Scholarship	362
9	Zhejiang Natural Science Foundation	357
10	Hunan Natural Science Foundation	285

Note: Listed in descending order of the number of papers supported by various funds.
Data comes from CNKI.

Tab. 2.22 – Number and percentage of the funded papers by discipline published in China's English language STM journals, 2020 (Top 20 disciplines).

No.	Discipline	No. of paper (A)	No. of funded paper (B)	% ($B/A \times 100\%$)
1	Safety Science & Technology	12	12	100.00
2	Horticulture	257	251	97.67
3	Aquaculture	128	123	96.09
4	Agronomy	514	493	95.91
5	Chemistry	2186	2089	95.56
6	Plant Protection	291	275	94.50
7	Metallurgical Engineering Technology	243	226	93.00
8	Geology	905	828	91.49
9	Animal Husbandry, Veterinary Science	327	297	90.83
10	Astronomy	368	334	90.76
11	Chemical Engineering	2305	2087	90.54
12	Materials Science	2540	2299	90.51
13	Physics	1694	1531	90.38
14	Forestry	373	337	90.35
15	Mechanical Engineering	333	300	90.09
16	Nuclear Science and Technology	185	166	89.73
17	Agricultural Basic Science	247	221	89.47
18	Marine Science	467	415	88.87
19	Textile Science & Technology	26	23	88.46
20	Electrical Engineering	1972	1744	88.44

Note: Papers are listed in descending order by the percentage of papers funded.
This table counts all the papers supported by the fund, without limiting the size of the fund.
Data comes from CNKI.

2.2.2.5 Overseas-Authored Papers and Overseas Collaborated Papers in China's English Language STM Journals

In 2020, there were 7032 papers by overseas authors and 3984 overseas collaborative papers published in China's English language STM Journals. There are 34 disciplines with significant numbers of papers from overseas authors and papers that include overseas collaborators. The list in table 2.23 includes disciplines with at least ten papers and more than 10% of all papers published including overseas authors or overseas collaborators. In descending order of the total number of overseas papers, the three disciplines with the highest number of papers are: "materials science" (979 papers), "automation technology, computer technology" (825 papers), and "biology" (809).

For papers published by authors from the Hong Kong, Macao, and Taiwan regions of China and papers published in collaboration with authors from the Hong Kong, Macao, and Taiwan regions of China, please see table 2.24; for papers published by authors from other countries and papers published in collaboration with other countries, please see table 2.25.

2.2.3 Impact Analysis of China's English Language STM Journals

2.2.3.1 Citable Literature Per Journal

According to the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions, the number of the citable articles per journal in China's English language STM journals has decreased from 113.9 papers in 2016 to 107.42 papers, showing a downward trend, and the average decrease rate is 5.10%, the average annual deduction rate is 1.30% (table 2.26). This level of articles per journal is lower than the average number of articles in international journals (which is 213.29) reported by JCR, and also far lower than the average number of articles in Chinese language journals (276.68).

2.2.3.2 Total Citations

According to the *Impact Factor Annual Report* and the *International Citation Annual Report*, domestic composite times cited refers to the total citations of the citable articles published in the statistical year by articles from the source journals included in the *Impact Factor Annual Report*, doctoral and master's dissertations, conference proceedings, reflecting the domestic academic influence of those English language journals. International composite times cited refers to the number of times cited by over 21 000 types of academic journals, books and conference proceedings, reflecting the international academic influence of the English language journals.

The total number of times cited articles in China's English language STM journals home and abroad in 2020 is 785 200, of which the domestic times cited are 245 400, and the international times cited are 596 500 (table 2.27). From 2016 to 2020, the total times cited both from home and abroad and the citations per journal have increased in general; the growth rate of total citations is 15.03%, and the growth rate of times cited per journal is 10.35%. In the past five years, the international composite total times cited in China's

TAB. 2.23 – Number of overseas papers published in China's STM journals in selected disciplines, 2020.

No.	Discipline	No. of papers in this discipline (A)	Papers by overseas authors		Papers from overseas collaborations		Overseas papers	
			No. of papers (B)	% ($B/A \times 100\%$)	No. of papers (C)	% ($C/A \times 100\%$)	Total no. of overseas papers ($B + C$)	% [$(B + C)/A \times 100\%$]
1	Materials Science	2540	618	24.33	361	14.21	979	38.54
2	Automation Technology, Computer Technology	2291	482	21.04	343	14.97	825	36.01
3	Biology	1853	513	27.68	296	15.97	809	43.66
4	Electrical Engineering	1972	383	19.42	350	17.75	733	37.17
5	Chemical Engineering	2305	397	17.22	306	13.28	703	30.50
6	Environmental Science and Technology	1650	392	23.76	219	13.27	611	37.03
7	Physics	1694	342	20.19	236	13.93	578	34.12
8	Chemistry	2186	285	13.04	277	12.67	562	25.71
9	Radio Electronics, Telecommunications Technology	1860	313	16.83	212	11.40	525	28.23
10	Mathematics	1393	295	21.18	173	12.42	468	33.60
11	Metallurgy and Metalwork	1453	281	19.34	159	10.94	440	30.28
12	Basic Medicine	810	235	29.01	106	13.09	341	42.10
13	Oncology	1189	211	17.75	130	10.93	341	28.68
14	Civil Engineering	657	258	39.27	81	12.33	339	51.60
15	Geology	905	194	21.44	117	12.93	311	34.36
16	Neurology and Psychiatry	711	228	32.07	77	10.83	305	42.90
17	Transportation Engineering	881	181	20.54	106	12.03	287	32.58
18	Oil & Gas Industry	381	110	28.87	46	12.07	156	40.94
19	Agronomy	514	86	16.73	68	13.23	154	29.96
20	Animal Husbandry, Veterinary Science	327	96	29.36	46	14.07	142	43.43

Tab. 2.23 – (continued).

21	Pharmacology	428	90	21.03	52	12.15	142	33.18
22	Astronomy	368	75	20.38	65	17.66	140	38.04
23	Atmospheric Science	528	61	11.55	72	13.64	133	25.19
24	Marine Science	467	76	16.27	54	11.56	130	27.84
25	Plant Protection	291	76	26.12	43	14.78	119	40.89
26	Mining Engineering Technology	227	79	34.80	30	13.22	109	48.02
27	Energy and Power Engineering	273	79	28.94	30	10.99	109	39.93
28	Agricultural Basic Sciences	247	71	28.74	35	14.17	106	42.91
29	Mechanical Engineering	333	66	19.82	37	11.11	103	30.93
30	Horticulture	257	60	23.35	40	15.56	100	38.91
31	Geophysics	268	66	24.63	34	12.69	100	37.31
32	Hydraulic Engineering	152	57	37.50	18	11.84	75	49.34
33	Agricultural Engineering	87	52	59.77	10	11.49	62	71.26
34	Physical Geography	85	34	40.00	10	11.76	44	51.76

Note: Listed in descending order of the total number of overseas papers.

Data comes from CNKI.

These disciplines are especially those disciplines with more than 10 overseas-authored papers and overseas-collaborated papers, and the percentage of the overseas papers among all published papers is higher than 10%.

Tab. 2.24 – Number of papers published in China's English language STM journals by authors from the Hong Kong, Macao and Taiwan regions in 2020.

No.	Region	No. of papers by overseas authors	No. of overseas collaboration papers	Total no. of papers
1	Hong Kong	187	283	470
2	Macao	40	74	114
3	Taiwan	35	35	70

Tab. 2.25 – Number of papers published by overseas authors in China's English language STM journals in 2020 (Top 20 countries).

No.	Country	No. of papers by overseas authors	No. of collaboration papers	Total no. of papers
1	USA	1594	1513	3107
2	UK	318	443	761
3	Australia	311	393	704
4	India	469	48	517
5	Germany	278	225	503
6	Iran	456	17	473
7	Canada	242	230	472
8	Japan	270	186	456
9	Korea	280	68	348
10	Singapore	129	156	285
11	Italy	220	53	273
12	France	150	116	266
13	Spain	164	29	193
14	Pakistan	94	67	161
15	Russia	114	45	159
16	Brazil	132	15	147
17	Saudi Arabia	78	58	136
18	Türkiye	119	13	132
19	Netherlands	72	54	126
20	Sweden	57	67	124

Note: Listed in descending order of the total number of overseas papers.
Data comes from CNKI.

English language STM journals have exceeded the domestic ones, and the proportion of international times cited has increased rapidly, from 245 600 in 2016 to 596 500 in 2020. The average annual growth rate over the past five years is as high as 24.84%, and the proportion of international times cited has increased from 54.75% in 2016 to 75.98% in 2020. It is noteworthy that the rate of increase of domestic citations has been as fast as the international citations, but rather has a decreasing and then slowly increasing trend. Therefore, we should pay more attention to the domestic influence of China's English language STM journals and increase their dissemination and utilization rate in China, so as to better play their due role in supporting scientific research and economic construction in China.

Tab. 2.26 – Numbers of citable articles in China's English language STM journals from 2016 to 2020.

Statistical year	No. of citable iterature (A)	No. of journals (B)	No. of citable literature per journal (A/B)
2016	24 448	216	113.19
2017	24 384	220	110.84
2018	25 328	237	106.87
2019	25 901	251	103.19
2020	27 391	255	107.42

Note: Data is from the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions.

Tab. 2.27 – China's English language STM journals cited home and abroad, 2016–2020.

Year	No. of journals	Domestic composite times cited (*A*)	International citations (*B*)	Total citations at home and abroad (*C*)*	Growth rate/%	Citations per journal (*C*)/No. of journals	% of international citations/% (*B*/*C* × 100%)
2016	216	239 864	245 578	448 528	—	2076.52	54.75
2017	220	238 797	281 302	481 299	7.31	2187.72	58.45
2018	237	234 314	351 814	542 511	12.72	2289.08	64.85
2019	251	239 993	432 837	625 629	15.32	2492.55	69.18
2020	255	245 390	596 530	785 165	25.50	3079.08	75.98

Note: The data is from the *Impact Factor Annual Report 2017 to 2021 Editions* and the *International Citation Annual Report* 2017 to 2021 Editions.
Due to the fact that some journals are included in the SCI databases and simultaneously included as source journals in CNKI's *Impact Factor Annual Report*, journal citations from both domestic and international sources have been aggregated and deduplicated to ensure data accuracy.
The growth rate is the year-on-year increase in total citations both domestically and internationally.
* $C = (A + B)$ after deduplication.

2.2.3.3 Impact Factor and Immediacy Index

According to the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions (table 2.28), China's English language STM journals' composite impact factor per journal was 0.901 in 2020, increasing by 7.65% over 2019, and by 20.13% over 2016. The average annual increase rate over the five-year period was 4.69%. The immediacy index per journal in 2020 was 0.241, increasing by 41.76% over 2019, and 72.14% over 2016, with an average annual increase rate during the period of 14.54%.

According to the *International Citation Annual Report* 2017–2021 editions (table 2.28), the average citation impact factor of the top journals of international influence in 2020 was 3.835, increasing by 30.71% year on year, increasing by 115.33% over 2016, and at an annual increase rate of 21.14%. The international citation immediacy index in 2020 was 1.672, increasing by 111.91% year on year, up 326.53% over 2016, and at an average increase rate of 43.71%.

Tab. 2.28 – Domestic and international impact factor and immediacy index of English language STM journals in China 2016–2020.

Statistical year	Domestic impact data			International impact data (TOP journals)		
	No. of journals	Composite impact factor per journal	Composite immediacy index per journal	No. of journals	Citation impact factor per journal	Citation immediacy index per journal
2016	216	0.750	0.140	170	1.781	0.392
2017	220	0.780	0.167	187	2.048	0.530
2018	237	0.778	0.167	198	2.449	0.701
2019	251	0.837	0.170	212	2.934	0.789
2020	255	0.901	0.241	230	3.835	1.672

Note: Data is from the Annual Report for Chinese Academic Journals Impact Factors 2017–2021 editions and the Annual Report for International Citation of Chinese Academic Journals (Natural Science) Editions 2017–2021.

2.2.3.4 Self-Citation Rate

According to the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 *editions* (table 2.29), the average self-citation rate of China's English language STM journals over the past five years is about 18%. In 2020, journals with a self-citation rate of less than 20% accounted for 56.47%, while journals with a self-citation rate of 20% or higher accounted for 43.53%. The annual changes in the data show that the number of journals with a self-citation rate of 20% or more has increased slightly.

2.2.3.5 Internet Dissemination Indices

According to the statistics of the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions (table 2.30), the total downloads of China's English language STM journals from the CNKI website showed a fluctuating trend, first decreasing and then increasing. The total number of downloads in 2020 was 2.058 million, a year-on-year decrease of about 3% from the previous year and a decrease of 13.23% from 2016. The web immediacy download generally shows an upward trend, reaching 351 400 in 2020, with an increase of 18.52% compared to the previous year. The ratio of web immediacy downloads to total downloads continues to increase, reaching 17.07% in 2020, an increase of 3.1 percentage points compared to the previous year and an increase of 8.1 percentage points compared to 2016. The web immediacy download rate per journal was 16.23 articles in 2020, an increase of 16.59% year-on-year and 47.55% compared to 2016.

2.2.3.6 Distribution by Disciplines of Impact Factors of China's English Language STM Journals

According to the statistics of the 255 English language STM journals included in the *Annual Report for Chinese Academic Journals Impact Factors* (table 2.31), these journals

Tab. 2.29 – Distribution of self-citation rate of China's English language STM journals 2016–2020.

Statistical year	No. of journals	Self-citation rate/%											
		0 ~		10 ~		20 ~		30 ~		40 ~		50 ~	
		No. of journals	%	No. of journals	%	No. of journals	%	No. of journals	%	No. of journals	%	No. of journals	%
2016	216	68	31.48	71	32.87	38	17.59	15	6.94	15	6.94	9	4.17
2017	220	78	35.45	57	25.91	40	18.18	28	12.73	11	5.00	6	2.73
2018	237	70	29.54	81	34.18	36	15.19	33	13.92	8	3.38	9	3.80
2019	251	70	27.89	77	30.68	52	20.72	27	10.76	19	7.57	6	2.39
2020	255	79	30.98	65	25.49	57	22.35	32	12.55	14	5.49	8	3.14

Note: Data is from the *Annual Report for Chinese Academic Journals Impact Factors* 2017–2021 editions.

Tab. 2.30 – Downloads of China's English language STM journals during 2016–2020.

Statistical year	Total downloads (A)	The web immediacy downloads (B)	Percentage of web immediacy downloads (B/A)/% ($B/A \times 100\%$)	Increase rate of web immediacy downloads year-on-year (%)	The web immediacy download rate per journal
2016	2 371 655	213 006	8.98	—	11.00
2017	1 910 127	177 361	9.29	−16.73	9.04
2018	1 973 220	218 797	11.09	23.36	10.61
2019	2 121 172	296 466	13.98	35.50	13.92
2020	2 058 000	351 366	17.07	18.52	16.23

Note: The data source is the *Annual Report for Chinese Academic Journals Impact Factors 2017–2021 editions*.

The statistical scope includes all English language STM journals listed in full text on the CNKI website and the *Annual Report for Chinese Academic Journals Impact Factors*.

The growth rate is the year-on-year increase in web immediacy downloads.

cover 56 disciplines, with "biology" (24 journals) having the highest number of journals, "physics" (2863 papers) having the highest number of citable articles, and "biology" having the highest number of composite citations (33 400).

According to the statistics in the *International Citation Annual Report* 2021 edition (table 2.32), 230 China's English language STM journals were selected as Top Journals of International Impact and they cover 55 disciplines.

2.2.3.7 International Impact Analysis of China's English Language STM Journals

The World Journal Clout Index (WJCI) 2021 (the statistical year is 2020) included 277 English language STM journals in China, with 22 journals added in 2019. The number of citations per journal was 2157.25, the impact factor per journal was 3.205, and the WJCI score per journal was 2.324.

Three English language STM journals have the highest *World Journal Clout Index WJCI*, namely *National Science Review* (WJCI: 25.333), *Science Bulletin* (WJCI: 17.899), and *Cell Research* (WJCI: 12.029). The three journals with the highest total times cited are *Cell Research* (cited 20 815 times), *Nano Research* (cited 17 532), and *Journal of Environmental Sciences* (cited 15 464). The three journals with the highest impact factor are *Electrochemical Energy Reviews* (24.238), *Cell Research* (22.164), and *Fungal Diversity* (20.930).

According to Altmetric statistics, the top three journals with the highest total mentions were Cell Research (13 587 times), Cellular & Molecular Immunology (11 561 times), and National Science Review (10 527 times). The three journals with the highest article views and full-text downloads from domestic databases (CNKI, Wanfang Data, and CMA Journals Full-text Database) were: *Chinese Medical Journal* (353 526 times), *Acta Geochimica* (310 069 times), and *Chinese Journal of Catalysis* (133 760 times).

Tab. 2.31 – Domestic impact data of China's English language STM journals in various disciplines 2020.

No.	Discipline	No. of journals	No. of citable articles	Web immediacy download rate	Composite total citations	Total citations per journal	Avg. composite impact factor	Avg. composite immediacy index	Avg. cited half-life (yr)
1	Biology	24	2124	16.46	33 396	1391.50	0.944	0.493	7.04
2	Mathematics	17	1031	7.00	4381	257.71	0.218	0.052	8.27
3	Engineering Technology in General	15	1415	23.50	13 242	882.80	0.637	0.137	5.71
4	Radio Electronics Telecommunications	14	1731	15.55	11 040	788.57	0.771	0.110	3.96
5	Physics	13	2863	6.33	17 624	1355.69	0.875	0.238	4.16
6	Automation Technology, Computer Technology	11	1219	18.86	8851	804.64	1.008	0.147	4.06
7	Chemistry	11	2736	32.00	21 163	1923.91	1.788	0.392	3.38
8	Materials Science	10	2212	24.63	25 841	2584.10	1.361	0.243	4.43
9	Metal Science & Metalwork	9	1756	13.75	20 207	2245.22	1.369	0.234	4.49
10	Traditional Chinese Medicine & Pharmacology	9	679	15.88	7809	867.67	0.802	0.191	5.07
11	Geophysics	8	555	11.83	7772	971.50	0.901	0.205	5.16
12	Geology	7	715	10.86	5797	828.14	0.728	0.125	5.00
13	Civil Engineering	7	462	11.50	2966	423.71	0.719	0.123	4.06
14	Pharmacology	6	633	21.20	7335	1222.50	1.284	0.306	4.28
15	Environmental Science & Technology	6	616	47.00	8458	1409.67	0.955	0.258	4.37
16	Marine Science	6	601	12.67	3302	550.33	0.417	0.078	6.18
17	Atmospheric Science	6	469	20.60	4438	739.67	0.891	0.198	5.25
18	Mechanics	6	630	6.33	5738	956.33	0.891	0.213	5.13

Tab. 2.31 – (continued).

No.	Discipline	No. of journals	No. of citable articles	Web immediacy download rate	Composite total citations	Total citations per journal	Avg. composite impact factor	Avg. composite immediacy index	Avg. cited half-life (yr)
19	Energy & Power Engineering	5	462	9.33	2821	564.20	1.328	0.163	3.50
20	Metallurgical Engineering	5	929	18.75	13 868	2773.60	1.181	0.219	5.28
21	Technology Natural Geography	5	529	18.20	5921	1184.20	1.136	0.162	4.68
22	Natural Science & Engineering Technology in General	5	765	27.80	10 446	2089.20	1.287	0.610	4.58
23	Natural Geography Medicine & Health in General	4	308	26.50	2202	550.50	0.990	0.667	3.23
24	Oncology	4	274	5.75	3060	765.00	1.877	0.170	4.35
25	Neurology & Psychiatry	4	594	11.50	4832	1208.00	0.947	0.280	5.95
26	Surgery	4	248	9.00	2126	531.50	1.071	0.160	4.18
27	Agricultural Science in General	4	411	16.25	4773	1193.25	0.558	0.283	5.13
28	Transportation Engineering	4	333	13.50	1952	488.00	0.480	0.159	5.63
29	Mechanical Engineering	4	266	64.00	2736	684.00	1.112	0.110	4.03
30	Chemical Engineering	4	602	8.00	4038	1009.50	0.931	0.122	4.23
31	Basic Medicine	3	389	5.00	3343	1114.33	0.986	0.616	4.30
32	Electrical Engineering	3	130	7.00	353	117.67	1.217	0.101	2.23

Tab. 2.31 – (continued).

33	Clinical Medicine in General	3	369	5.50	696	232.00	0.998	0.266	2.50
34	Oil & Gas Industry	3	304	7.00	1262	420.67	0.631	0.063	4.17
35	Agronomy	2	137	13.00	974	487.00	1.067	0.174	4.70
36	Internal Medicine	2	80	5.00	495	247.50	0.704	0.297	4.25
37	Forestry	2	298	7.00	1372	686.00	0.694	0.086	5.35
38	Stomatology	2	69	13.00	509	254.50	0.969	0.966	3.30
39	Mining Engineering Technology	2	174	5.00	2958	1479.00	1.448	0.248	5.45
40	Otorhinolaryngology & Ophthalmology	2	92	—	150	75.00	0.339	0.119	3.15
41	Surveying and Mapping Science & Technology	2	76	10.00	348	174.00	1.091	0.529	3.65
42	Basic Disciplines Of Engineering and Technology	2	283	22.00	1847	923.50	2.077	0.213	3.35
43	Aeronautical and Astronautical Science & Technology	2	378	23.50	3307	1653.50	0.920	0.131	4.95
44	Hydraulic Engineering	2	92	4.00	737	368.50	0.798	0.184	5.75
45	Astronomy	2	394	7.50	2586	1293.00	1.077	0.526	3.60
46	Animal Husbandry, Veterinary Science	2	159	11.00	1130	565.00	1.328	0.187	3.30
47	Horticulture	1	44	10.00	184	184.00	1.603	0.205	2.70
48	Systems Science	1	26	—	339	339.00	0.346	0.038	7.80
49	Weapon Industry & Military Technology	1	120	5.00	420	420.00	0.790	0.258	3.00
50	Nuclear Science & Technology	1	122	5.00	717	717.00	0.835	0.418	2.80

Tab. 2.31 – (continued).

No.	Discipline	No. of journals	No. of citable articles	Web immediacy download rate	Composite total citations	Total citations per journal	Avg. composite impact factor	Avg. composite immediacy index	Avg. cited half-life (yr)
51	Nursing	1	70	—	182	182.00	0.407	0.100	3.30
52	Textile Science & Technology	1	73	16.00	218	218.00	0.129	0.014	5.50
53	Obstetrics, Gynecology & Pediatrics	1	85	—	558	558.00	0.815	1.447	2.70
54	Dermatology & Venereology	1	41	—	395	395.00	0.071	0.024	7.00
55	Light Industry (Excl Textile and Food)	1	26	9.00	205	205.00	1.017	0.192	4.30
56	Agricultural Basic Science	1	79	14.00	1949	1949.00	0.857	0.278	9.20
	Total	255	27 391	16.92	245 390	962.31	1.060	0.283	4.56

Note: The data source is the *Annual Report for Chinese Academic Journals Impact Factors* 2021 edition.
There are journals that belong to two or more disciplines.
The total number is the result after deduplication.

Tab. 2.32 – International impact data of Top Journals of International Impact in various disciplines in 2020 (China's English language STM journals).

No.	Discipline	No. of journals	Int'l total citations (w/o self cites)	Int'l total citations (w/o self cites) per journal	Avg. impact factor	Avg. immediacy index
1	Biology	26	98 971	3806.58	5.581	3.198
2	Materials Science	13	72 709	5593.00	5.240	1.122
3	Physics	13	48 487	3729.77	3.627	1.135
4	Chemistry	12	59 807	4983.92	7.675	2.357
5	Radio Electronics, Telecommunications	12	17 758	1479.83	2.991	0.639
6	Automation Technology, Computer Technology	12	15 333	1277.75	2.175	0.702
7	Mathematics	9	10 679	1186.56	1.063	0.258
8	Metal Science & Metalwork	8	42 115	5264.38	2.544	0.804
9	Engineering Technology in General	8	23 060	2882.50	2.277	0.655
10	Environmental Science & Technology	7	24 059	3437.00	3.365	0.690
11	Geology	7	15 495	2213.57	2.709	1.008
12	Civil Engineering	7	9746	1392.29	2.386	0.894
13	Metallurgical Engineering Technology	6	29 068	4844.67	2.954	0.741
14	Mechanics	6	13 735	2289.17	2.283	1.029
15	Geophysics	6	11 708	1951.33	2.201	0.509
16	Pharmacy	5	26 720	5344.00	6.113	3.193
17	Medicine & Health in General	5	15 983	3196.60	2.481	4.944
18	Neurology & Psychiatry	5	14 173	2834.60	4.334	1.961
19	Traditional Chinese Medicine & Herbalism	5	9203	1840.60	1.869	1.432
20	Energy & Power Engineering	5	6560	1312.00	3.653	0.957
21	Natural Science & Engineering Technology in General	4	19 429	4857.25	10.782	6.038

Tab. 2.32 – (continued).

No.	Discipline	No. of journals	Int'l total citations (w/o self cites)	Int'l total citations (w/o self cites) per journal	Avg. impact factor	Avg. immediacy index
22	Chemical Engineering	4	13 435	3358.75	3.896	0.913
23	Physical Geography	4	10 510	2627.50	2.496	0.505
24	Surgery	4	9205	2301.25	5.185	1.248
25	Atmospheric Science	4	8023	2005.75	2.631	0.505
26	Marine Science	4	5541	1385.25	1.102	0.237
27	Internal Medicine	4	5148	1287.00	2.711	2.060
28	Basic Medicine	3	13 068	4356.00	5.932	5.126
29	Oncology	3	6329	2109.67	4.087	0.578
30	Clinical Medicine in General	3	4810	1603.33	7.846	4.188
31	Mechanical Engineering	3	4328	1442.67	3.568	0.472
32	Oil & Gas Industry	3	3497	1165.67	2.725	0.769
33	Transportation Engineering	3	2142	714.00	1.938	0.945
34	Engineering & Technology Science Basic Disciplines	2	7703	3851.50	8.735	2.088
35	Agricultural Science in General	2	5973	2986.50	2.146	0.542
36	Astronomy	2	5588	2794.00	2.800	1.538
37	Animal Husbandry & Veterinary Science	2	4974	2487.00	5.587	0.960
38	Mining Engineering Technology	2	4131	2065.50	2.650	0.814
39	Agronomy	2	3504	1752.00	3.681	1.012
40	Forestry	2	3480	1740.00	2.683	0.580
41	Stomatology	2	3323	1661.50	4.328	14.266
42	Horticulture	2	2794	1397.00	4.449	0.782
43	Hydraulic Engineering	2	2417	1208.50	2.560	0.709
44	Electrical Engineering	2	646	323.00	5.361	0.812
45	Agricultural Basic Science	1	4733	4733.00	3.884	2.139
46	Aeronautical and Astronautical Science & Technology	1	3700	3700.00	2.212	0.828

Tab. 2.32 – (continued).

No.	Discipline	No. of journals	Int'l total citations (w/o self cites)	Int'l total citations (w/o self cites) per journal	Avg. impact factor	Avg. immediacy index
47	Obstetrics, Gynecology, & Pediatrics	1	2198	2198.00	2.676	11.446
48	Weapon Industry & Military Technology	1	1355	1355.00	3.000	1.142
49	Nuclear Science & Technology	1	1267	1267.00	1.391	0.474
50	Otorhinolaryngology & Ophthalmology	1	890	890.00	3.200	1.509
51	Surveying And Mapping Science & Technology	1	830	830.00	3.814	0.711
52	Systems Science	1	727	727.00	1.090	0.214
53	Nursing	1	539	539.00	1.948	0.743
54	Food Science & Technology	1	412	412.00	3.085	0.286
55	Aquaculture	1	352	352.00	2.070	0.462
	Total	230	629 398	2736.51	3.558	1.693

Note: Data is from *Annual Report for International Citation of Chinese Academic Journals* 2021 edition.
Some journals can belong to two or more disciplines.
The total number is the result after the deduplication process.

According to the WJCI Report 2021, the international impact index, namely World Journal Clout Index WJCI of 102 STM journals ranked in the top 25% (Q1 zone), accounting for 36.82% of the shortlisted English language journals, and the number of English language STM journals included in each discipline and their rankings in each quartile are displayed in table 2.33.

2.2.3.8 China's English Language STM Journals Indexed in International Databases

With the rapid development of science and technology in China, China's English language STM journals have gained increasingly prominent positions and roles in international academic exchanges, and thus have received more attention and recognition from internationally renowned databases. Here we select Web of Science (WoS), two comprehensive citation databases of Scopus, EI (Engineering Technology), PubMed (Biology and Medicine), Chemical Abstracts-ACS (Chemistry), MathSciNet-MSN (Mathematics), GeoRef (Earth Sciences), and six professional abstract databases of CAB Abstracts

Tab. 2.33 – Number of China's English language STM journals in each discipline indexed by WJCI Report 2021.

No.	Disciplines	No. of journals	No. of journals in each quartile of ranking			
			Q1	Q2	Q3	Q4
1	Earth Sciences	27	5	11	6	5
2	Clinical Medicine	26	7	8	6	5
3	Biology	25	10	7	6	2
4	Mathematics	19	7	1	3	8
5	Physics	17	6	6	2	3
6	Materials Science	14	5	6	2	1
7	Chemistry	10	5	1	1	3
8	Electronics and Communications Technology	10	2	4	2	2
9	Environmental Science & Technology and Resources Science & Technology	9	3	2	2	2
10	Agronomy	8	4	4	0	0
11	Science and Technology in General	7	5	1	1	0
12	Basic Medicine	6	2	1	3	0
13	Metallurgical Engineering Technology	6	5	1	0	0
14	Civil Engineering	6	1	3	1	1
15	Information Science and System Science	5	2	1	2	0
16	Pharmacology	5	2	1	1	1
17	Traditional Chinese Medicine and Pharmacology	5	0	3	1	1
18	Engineering in General	5	3	2	0	0
19	Computer Science and Technology	5	3	2	0	0
20	Mechanics	4	1	1	2	0
21	Medicine in General	4	2	2	0	0
22	Information and Systems Science Related Engineering & Technology	4	3	0	1	0
23	Mining Engineering Technology	4	4	0	0	0
24	Power and Electrical Engineering	4	0	1	3	0
25	Energy Science and Technology	4	1	1	2	0
26	Transportation Engineering	4	1	2	0	1
27	Basic Disciplines of Engineering General Technology	3	2	1	0	0
28	Natural Science-related Science and Technology	3	1	0	2	0
29	Mechanical Engineering	3	2	1	0	0
30	Chemical Engineering	3	0	3	0	0
31	Hydraulic Engineering	3	2	1	0	0
32	Aeronautical and Astronautical Science and Technology	3	2	0	0	1
33	Preventive Medicine and Public Health	2	0	1	1	0

Tab. 2.33 – (continued).

No.	Disciplines	No. of journals	No. of journals in each quartile of ranking			
			Q1	Q2	Q3	Q4
34	Forestry	2	1	0	0	1
35	Animal Husbandry and Veterinary Science	2	2	0	0	0
36	Surveying & Mapping Science and Technology	2	0	2	0	0
37	Nuclear Science and Technology	2	0	1	0	1
38	Instrumentation Technology	2	0	0	1	1
39	Astrology	1	0	0	1	0
40	Aquaculture	1	0	1	0	0
41	Food Science and Technology	1	0	0	1	0
42	Safety Science and Technology	1	1	0	0	0
	Total	277	102	83	53	39

Note: Listed in descending order of the number of English language journals included.
The data is from the *WJCI Report* 2021.
For cases where a journal spans multiple disciplines, take the discipline with the highest percentile ranking percentile.

(Agriculture) to count the indexing of China's English STM journals. By July 2022, there were 353 English-language STM journals in China indexed by at least one of the above databases, accounting for 84.05% of all English-language STM journals published in China. The number of China's English language STM journals indexed by international databases is shown in table 2.34. Compared with the same period last year, 43 English language STM journals have been added. Check table 2.35 for the list of indexed journals.

Tab. 2.34 – Number of China's English language STM journals indexed by eight international databases.

No.	Database	Discipline	No. of journals indexed
1	WoS	General	273
2	Scopus	General	295
3	EI	Engineering Technology	120
4	PubMed	Biology and Medicine	72
5	ACS	Chemistry	196
6	CAB Abstracts	Agriculture	65
7	GeoRef	Earth Sciences	38
8	MSN	Mathematics	30

TAB. 2.35 – China's English language STM journals newly indexed by eight international databases 2022.

No.	Title (ENG)	Title (CHN)	Newly indexed databases
1	*Statistical Theory and Related Fields*	统计理论及其应用 (英文)	Scopus
2	*Journal of Interventional Medicine*	介入医学杂志 (英文)	Scopus, PubMed
3	*Chinese Journal of Natural Medicines*	中国天然药物	WoS, Scopus, PubMed, ACS, CAB Abstracts
4	*International Journal of Dermatology and Venereology*	国际皮肤性病学杂志 (英文)	Scopus
5	*Energy & Environmental Materials*	能源与环境材料 (英文)	WoS, Scopus, EI, ACS
6	*Infectious Microbes & Diseases*	感染微生物与疾病 (英文)	WoS, ACS
7	*Journal of Control Theory and Applications*	控制理论与技术 (英文)	WoS, EI, MSN
8	*Regional Sustainability*	区域可持续发展 (英文)	Scopus
9	*Transportation Safety and Environment*	交通安全与环境 (英文)	WoS, Scopus, EI
10	*Regenerative Biomaterials*	再生生物材料 (英文)	WoS, Scopus, EI, ACS
11	*Nanomanufacturing and Metrology*	纳米制造与计量 (英文)	Scopus, EI, ACS
12	*Communications in Mathematics and Statistics*	数学与统计通讯 (英文)	WoS, Scopus
13	*Marine Life Science & Technology*	海洋生命科学与技术 (英文)	WoS, Scopus, ACS
14	*Satellite Navigation*	卫星导航 (英文)	WoS
15	*Food Science and Human Wellness*	食品科学与人类健康 (英文)	WoS, Scopus, ACS
16	*China CDC Weekly*	中国疾病预防控制中心周报 (英文)	WoS
17	*Soil Ecology Letters*	土壤生态学快报 (英文)	WoS, Scopus, ACS
18	*Journal of Leather Science and Engineering*	皮革科学与工程 (英文)	ACS
19	*International Journal of Extreme Manufacturing*	极端制造 (英文)	WoS, Scopus, EI, ACS
20	*Acta Epilepsy*	癫痫学报 (英文)	Scopus
21	*Information Processing in Agriculture*	农业信息处理 (英文)	Scopus, EI, CAB Abstracts
22	*Journal of Pancreatology*	胰腺病学杂志 (英文)	Scopus
23	*AgriBiotechnology*	生物技术通报 (英文)	Scopus, ACS

Tab. 2.35 – (continued).

No.	Title (ENG)	Title (CHN)	Newly indexed databases
24	*Phytopathology Research*	植物病理学报 (英文)	WoS, Scopus
25	*Journal of Systems Science and Information*	系统科学与信息学报 (英文)	Scopus
26	*Maternal-Fetal Medicine*	母胎医学杂志 (英文)	WoS, Scopus
27	*Chinese Annals of History of Science and Technology*	中国科学技术史 (英文)	Scopus, MSN
28	*Journal of Communications and Information Networks*	通信与信息网络学报 (英文)	Scopus, EI
29	*Plant Phenomics*	植物表型组学 (英文)	WoS, Scopus, EI, PubMed, ACS
30	*Synthetic and Systems Biotechnology*	合成和系统生物技术 (英文)	WoS, Scopus, ACS
31	*Biochar*	生物炭 (英文)	WoS, Scopus, ACS
32	*Bioactive Materials*	生物活性材料 (英文)	WoS, Scopus, EI, GeoRef
33	*Ecological Processes*	生态过程 (英文)	WoS, Scopus, EI, CAB Abstracts
34	*InfoMat*: *novel materials for next-generation information system*	信息材料 (英文)	WoS, Scopus, ACS
35	*Gynecology and Obstetrics Clinical Medicine*	妇产科临床医学 (英文)	Scopus
36	*Infectious Disease Modelling*	传染病建模 (英文)	WoS, Scopus
37	*Radiation Medicine and Protection*	放射医学与防护 (英文)	Scopus
38	*Waste Disposal & Sustainable Energy*	废弃物处置与可持续能源 (英文)	Scopus
39	*Unmanned Systems*	无人系统 (英文)	WoS, Scopus, EI
40	*Journal of Biosafety and Biosecurity*	生物安全和生物安保 (英文)	Scopus, ACS
41	*Artificial Intelligence in Agriculture*	农业人工智能 (英文)	Scopus
42	*Energy Material Advances*	能源材料前沿 (英文)	ACS
43	*Emerging Contaminants*	新兴污染物 (英文)	Scopus, ACS

2.2.3.9 Statistics of China's English Language STM Journals in JCR Report

Journal Citation Reports® (JCR) is a multidisciplinary journal evaluation tool developed by Clarivate Analytics. JCR has 2 editions, the Science Edition and the Social Sciences Edition. JCR statistics in this Blue Book refer specifically to the JCR Science Edition, and so "JCR" hereafter refers to the JCR Report Science Edition. JCR 2021 refers to the JCR

Report Science Edition published in 2021, and the corresponding statistical year for the data is 2020, and so on.

2.2.3.9.1 Number of China's English Language STM Journals Reported in JCR

According to JCR from 2017 to 2021 (table 2.36), the number of China's English language STM journals reported in JCR has shown an upward trend. In JCR 2021, 203 of China's English language STM journals were included, an increase of 8% over the previous year, with a growth rate of 4.12%, an increase of 40.97% over the number of 144 journals five years ago, and an annual increase rate of 8.96%. JCR lists journals in the order of impact factor by discipline, defining the top quartile of journals as Q1, and so on, dividing journals into Q1, Q2, Q3 and Q4. JCR 2021 reported 85 English language STM journals in China in Q1, which increased by 12 journals with a growth of 16.44%. This number had increased by 142.86% compared with the 35 titles five years ago, with an annual growth rate of 24.84%.

Tab. 2.36 – Number of China's English language STM journals reported in JCR 2017–2021.

Statistical year	Number of journals	Number of journals in each quartile			
		Q1	Q2	Q3	Q4
2016	144	35	39	49	50
2017	160	50	49	46	41
2018	172	54	48	57	43
2019	195	73	66	64	23
2020	203	85	79	56	18

Note: There are journals belonging to more than one disciplines, therefore they are counted in more than one quartile zone.

2.2.3.9.2 Total Citations and Impact Factors of China's English Language STM Journals in JCR

According to the statistics of JCR 2017–2021 (table 2.37), the average total citations, the impact factor per journal, the average citation impact factor, and the average annual immediacy index of China's English language STM journals have shown an increasing trend year by year.

Tab. 2.37 – Major evaluation indicators of China's English language STM journals reported in JCR 2017–2021.

Statistical year	No. of journals	Average total citations	Impact factor per journal	Average citation impact factor	Average annual immediacy index
2016	144	1740.00	2.154	1.941	0.453
2017	160	1850.21	2.547	2.298	0.649
2018	172	2114.15	2.811	2.554	0.766
2019	195	2366.76	3.398	3.109	0.844
2020	203	3252.23	4.739	4.353	1.994

2.2.3.9.3 Top Three Journals from China in Global Impact Factor Ranking by Discipline

According to JCR 2021, there are 18 journals from China, all in English, among the top three STM journals ranked by impact factor by discipline (table 2.38).

Tab. 2.38 – Top three China's journals in impact factor ranking by discipline reported by JCR 2021.

No.	Title (ENG)	Title (CHN)	Discipline	Total citations	Impact factor	IF ranking by discipline
1	*Animal Nutrition*	动物营养 (英文)	Veterinary Sciences	1889	6.383	3/146
			Agriculture, Dairy & Animal Science	1889	6.383	2/63
2	*Asian Journal of Andrology*	亚洲男性学杂志 (英文)	Andrology	5215	3.285	3/8
3	*Bioactive Materials*	生物活性材料 (英文)	Engineering, Biomedical	2145	14.593	2/89
			Materials Science, Biomaterials	2145	14.593	1/41
4	*Bone Research*	骨研究 (英文)	Cell & Tissue Engineering	2665	13.567	2/29
5	*Electrochemical Energy Reviews*	电化学能源评论 (英文)	Electrochemistry	1341	28.905	1/29
6	*Fungal Diversity*	真菌多样性 (英文)	Mycology	5535	20.372	1/30
7	*Horticulture Research*	园艺研究 (英文)	Horticulture	2607	6.793	1/37
8	*Infectious Diseases of Poverty*	贫困所致传染病 (英文)	Tropical Medicine	3434	4.388	2/23
9	*Journal of Advanced Ceramics*	先进陶瓷 (英文)	Materials Science, Ceramics	1523	6.707	1/29
10	*Journal of Energy Chemistry*	能源化学 (英文版)	Chemistry, Applied	9463	9.676	2/74
11	*Journal of Magnesium and Alloys*	镁合金学报 (英文)	Metallurgy & Metallurgical Engineering	2726	10.088	1/80
12	*Journal of Materials Science & Technology*	材料科学与技术 (英文版)	Metallurgy & Metallurgical Engineering	13 679	8.067	3/80

Tab. 2.38 – (continued).

No.	Title (ENG)	Title (CHN)	Discipline	Total citations	Impact factor	IF ranking by discipline
13	*Journal of Ocean Engineering and Science*	海洋工程与科学(英文)	Engineering, Marine	519	3.408	3/16
14	*Journal of Sport and Health Science*	运动与健康科学(英文)	Sport Sciences	2746	7.179	3/88
15	*Light: Science & Applications*	光: 科学与应用(英文)	Optics	11 228	17.782	3/99
16	*National Science Review*	国家科学评论(英文)	Multidisciplinary Sciences	5889	17.275	3/72
17	*Petroleum Exploration and Development*	石油勘探与开发(英文)	Engineering, Petroleum	4738	3.803	3/20
18	*Petroleum Science*	石油科学(英文版)	Engineering, Petroleum	2101	4.090	2/20

2.2.3.10 Statistics of China's English Language STM Journals Reported by Scopus

CiteScore is a metric for evaluating scholarly journals, published annually by Elsevier since 2016, based on the Scopus database. CiteScore provides a simple measure of the citation impact of a Scopus-sourced publication (*e.g.*, a journal). The CiteScore methodology uses a four-year window. Calculating the CiteScore is based on the number of citations to documents (articles, reviews, conference papers, book chapters, and data papers) by a journal over four years, divided by the number of the same document types indexed in Scopus and published in those same four years.[4] The CiteScore report ranks the CiteScore metrics in descending order, dividing journals in the same discipline into four equal quartiles, labeled Q1, Q2, Q3, and Q4. For example, the CiteScore 2021 report counts the cumulative total number of citations and the average number of citations per article published in journals from 2017 to 2020 during the period from 2017 to 2020.

2.2.3.10.1 Number of China's English Language STM Journals Reported by CiteScore

According to CiteScore 2017–2021 statistics (table 2.39), the number of China's English language STM journals reported by CiteScore shows an upward trend. China's 257 English language STM journals were reported by CiteScore 2021, with an increase of 9.83% over the previous year. China's 133 English language STM journals were in the Q1 of CiteScore2021, an increase of 21 titles over the previous year, a growth rate of 18.75%.

[4] https://service.elsevier.com/app/answers/detail/a_id/14880/supporthub/scopus.

Tab. 2.39 – Number of China's English language STM journals reported by CiteScore 2017–2021.

Statistical year	No. of journals indexed	No. of journals in each quartile			
		Q1	Q2	Q3	Q4
2016	194	64	93	78	31
2017	206	77	91	79	26
2018	217	94	90	72	25
2019	234	112	98	72	26
2020	257	133	105	61	30

Note: For journals that span multiple disciplines, they are correspondingly counted in multiple regions.

2.2.3.10.2 CiteScore Evaluation Indicators of China's English Language STM Journals

The citation frequency in CiteScore refers to the total number of citations received by five types of citable literature (articles, reviews, conference papers, book chapters, and data papers) which are published by source publications in the statistical year and the three previous years, *i.e.*, the cumulative total number of times published papers have been cited over the past four years.

According to CiteScore 2021 (table 2.40), China's English language STM journals were cited a total of 1911.16 times over the past four years, an increase of 23.20% over the previous year. The average CiteScore per journal was 4.93, an increase of 17.94% over the same period last year.

Tab. 2.40 – Evaluation indicators of China's English language STM journals reported in CiteScore 2017–2021.

Statistical year	No. of journals included	Citations per journal	Average CiteScore per journal
2016	194	1114.12	2.80
2017	206	1224.27	3.20
2018	217	1371.33	3.76
2019	234	1551.21	4.18
2020	257	1911.16	4.93

2.2.3.10.3 Top Three of China's English Language STM Journals in Global Disciplinary Rankings by CiteScore

CiteScore2021 statistics show that there are 11 of China's journals, all in English, among the top 3 STM journals in the global disciplinary ranking by CiteScore (table 2.41).

Tab. 2.41 – Top 3 China's English language STM journals in global disciplinary ranking reported by CiteScore 2021.

No.	Title (ENG)	Title (CHN)	Discipline	CiteScore	Ranking
1	*Acta Pharmaceutica Sinica B*	药学学报 (英文)	Pharmacology, Toxicology and Pharmaceutics (all)	12.5	1/67
2	*Animal Nutrition*	动物营养 (英文)	Food Animals	7.7	1/32
3	*Bone Research*	骨研究 (英文)	Histology	19.2	2/60
4	*Engineering*	工程 (英文)	Materials Science (miscellaneous)	12.3	1/98
5	*Fungal Diversity*	真菌多样性 (英文)	Ecology, Evolution, Behavior and Systematics	30.7	1/647
			Ecology	30.7	1/400
6	*Genomics, Proteomics and Bioinformatics*	基因组蛋白质组与生物信息学报	Computational Mathematics	12.4	3/152
7	*Horticulture Research*	园艺研究 (英文)	Horticulture	6.1	3/86
8	*Information Processing in Agriculture*	农业信息处理 (英文)	Animal Science and Zoology	9.9	2/416
			Forestry	9.9	2/142
			Aquatic Science	9.9	3/224
9	*International Journal of Oral Science*	口腔科学杂志 (英文)	Dentistry (all)	13.6	1/111
10	*Journal of Energy Chemistry*	能源化学 (英文版)	Electrochemistry	10.8	3/41
			Energy (miscellaneous)	10.8	3/24
11	*Journal of Integrative Agriculture*	农业科学学报 (英文)	Food Animals	4.4	3/32

2.3 Analysis of China's STM Journal Influence

This section presents an analysis of China's SCI-indexed STM journals in 2021, based on indicator data from InCites,[5] including disciplines, international collaborations and

[5]Based on collecting and analyzing trusted Web of Science Core Collection data, InCites is a research performance evaluation and discipline analysis tool provided by Clarivate synthesizing various metrics and international benchmarking data in all disciplines over the past years. In this section, Essential Science Indicators (ESI) are used to categorize the disciplines of journals. Based on journal classifications, this categorizing model is a broader way of classifying disciplines including 22 science and social sciences disciplines. Each journal is assigned to only one discipline among the 22. The database has been updated as of July 29th, 2022, Web of Sciences data updated as of June 30th, 2022, the retrieval date is August 6th, 2022.

scholarly influence, and reveals the influence and international status of China's STM journals from a global perspective.

2.3.1 Disciplinary Distribution of Papers Published in China's SCI-Indexed Journals

This section presents a statistical analysis of global papers by discipline, looking at papers published by Chinese authors, papers published in China's SCI-indexed journals, and papers published by Chinese authors in China's SCI-indexed journals for the period of 2021, based on academic indicators such as paper volume, citation frequency, citation impact, highly cited papers, the percentage of international collaborations, and so on.

2.3.1.1 Volume of Papers Published in China's SCI-Indexed Journals

Chinese authors published 642 391 papers in SCI-indexed journals in 2021, accounting for 27.40% of the global total (2 344 852 papers). During the same period, the publication output of China's STM journals (232 journals[6]) was 35 045 papers, accounting for 1.49% of the global total. It is noteworthy that the number of papers published by Chinese authors in SCI-indexed journals was 18.33 times higher than the number of papers published in China's SCI-indexed journals. The number of papers published in China's SCI-indexed journals increased significantly (14%) to 30 742 papers in 2020, accounting for 1.45% of the global total; the rapid growth rate was higher than the increase in the number of China's SCI-indexed journals (8.92% over 2020 when there were 213 journals indexed). China's SCI-indexed journals were mainly contributed by Chinese researchers who published 30 006 papers in 2021, or 85.62%, a slight increase from 83.81% of the papers in 2020.

As shown in table 2.42, the global share of papers published in China's SCI-indexed journals in each discipline was lower than 5.00%. The top five disciplines were "physics" (4.59%), "geosciences" (3.77%), "materials science" (3.55%), "chemistry" (2.83%), and "space science" (1.63%). Except for "economics & business", "psychiatry/physiology", and "social sciences", for which the global share of papers published in China's SCI-indexed journals was 0%, the five disciplines with the lowest global shares were "microbiology" (0.31%), "multidisciplinary" (0.33%), "clinical medicine" (0.38%), "immunology" (0.61%), and "biology & biochemistry" (0.65%).

From the perspective of papers in various disciplines, there were seven disciplines, in which the number of SCI-indexed papers by Chinese authors accounted for more than 30% of the global total. They were "materials science" (45.39%), "computer science" (41.54%), "engineering" (39.99%), "geosciences" (35.76%), "molecular biology & genetics" (35.37%), "chemistry" (34.62%) and "physics" (32.26%).

The gap between the global share of SCI-indexed papers published by authors from China and that of papers published in China's STM journals was striking. There were six disciplines with a difference of more than 30 percentage points between the global share of papers published by authors from China and that of papers published in China's

[6]Data from 283 China's STM journals (excluding Hong Kong, Macau and Taiwan) were retrieved in InCites, and among the above, 51 journals didn't obtain a China number code (CN). Thus, 232 China's STM journals are included in the statistics of this section.

TAB. 2.42 – SCI-indexed papers in various disciplines published globally/in China's STM journals by Chinese authors (2021).

No.	Discipline	Number of global SCI papers (A)	Number of SCI papers in China's STM journals (B)	% (B/A × 100%)	Number of SCI papers by Chinese authors (C)	% (C/A × 100%)	Number of SCI papers by Chinese authors in China's STM journals (D)	% (D/C × 100%)	% (D/B × 100%)
1	Agricultural Sciences	73 984	1030	1.39	21 129	28.56	811	3.84	78.74
2	Biology & Biochemistry	98 522	641	0.65	25 784	26.17	586	2.27	91.42
3	Chemistry	230 558	6516	2.83	79 821	34.62	6212	7.78	95.33
4	Clinical Medicine	414 279	1561	0.38	73 182	17.66	1219	1.67	78.09
5	Computer Science	71 995	879	1.22	29 906	41.54	794	2.65	90.33
6	Economics & Business	44 793	0	0.00	7496	16.73	0	0.00	—
7	Engineering	279 074	3709	1.33	111 596	39.99	2930	2.63	79.00
8	Environment/Ecology	122 877	1426	1.16	34 230	27.86	1094	3.20	76.72
9	Geosciences	74 783	2817	3.77	26 743	35.76	2400	8.97	85.20
10	Immunology	38 162	233	0.61	7513	19.69	137	1.82	58.80
11	Materials Science	164 546	5847	3.55	74 687	45.39	5053	6.77	86.42
12	Mathematics	61 844	973	1.57	16 875	27.29	821	4.87	84.38
13	Microbiology	32 257	101	0.31	6602	20.47	95	1.44	94.06
14	Molecular Biology & Genetics	57 708	702	1.22	20 413	35.37	598	2.93	85.19
15	Multidisciplinary	3288	11	0.33	551	16.76	11	2.00	100.00
16	Neuroscience & Behavior	65 745	563	0.86	10 621	16.15	355	3.34	63.06
17	Pharmacology & Toxicology	61 089	868	1.42	16 910	27.68	745	4.41	85.83
18	Physics	115 561	5301	4.59	37 281	32.26	4800	12.88	90.55
19	Plant & Animal Science	98 405	1572	1.60	19 504	19.82	1098	5.63	69.85
20	Psychiatry/Psychology	67 938	1	0.00	6715	9.88	1	0.01	100.00

Tab. 2.42 – (continued).

21	Social Sciences, General	149 467	1	0.00	11 880	7.95	1	0.01	100.00
22	Space Science	17 977	293	1.63	2952	16.42	245	8.30	83.62
	Total	2 344 852	35 045	1.49	642 391	27.40	30 006	4.67	85.62

Note: Retrieval method – select "research area" in InCites dataset; publication time: 2021; Essential Science Indicators (ESI) as the discipline classification system; literature types: "research papers" and "review articles"; then sequentially retrieve the data of papers published globally, articles published in China's SCI journals, global papers by Chinese authors, and papers published by Chinese authors in China's SCI journals. Ranked in the alphabetical order of disciplines.

STM journals. These disciplines were "materials science" (41.84%), "computer science" (40.32%), "engineering" (38.66%), "molecular biology & genetics" (34.15%), "geosciences" (31.99%), and "chemistry" (31.79%).

There were seven disciplines for which the ratio of the global share of papers published by authors from China to that of papers published in China's SCI journals exceeded 30. They were "microbiology" (66.03), "multidisciplinary" (50.79), "clinical medicine" (46.47), "biology & biochemistry" (40.26), "computer science" (34.05), "immunology" (32.28) and "engineering" (30.07).

In 2021, the proportion of papers published by authors from China in China's SCI journals against the global papers published by authors from China was the highest in "physics" (12.88%), followed by "geosciences" (8.97%) and "space science" (8.30%). Among the sources of papers published in China's SCI journals, authors from China were the main contributors (85.62%), among which the proportion of Chinese authors exceeded 90.00% in eight disciplines, including "multidisciplinary" (100.00%), "psychiatry/psychology" (100.00%), "social sciences" (100.00%), "chemistry" (95.33%), "Microbiology" (94.06%), "Biology & Biochemistry" (91.42%), "Physics" (90.55%) and "computer science" (90.33%). Among the above disciplines, "chemistry", "physics" and "computer science" were the three disciplines in which both the global share of China's SCI papers and the global share of papers published by Chinese authors were comparatively higher than others. And "biology & biochemisty" and "microbiology" were two disciplines with a higher global share of papers published by Chinese authors and a lower global share of papers published in China's SCI journals. "Multidisciplinary", "psychiatry/psychology" and "social sciences" were the three disciplines in which both the global share of papers published in China's SCI journals and the global share of papers published by Chinese authors were comparatively lower.

2.3.1.2 Academic Influence of SCI Papers Published in China's SCI Journals

2.3.1.2.1 Total Citations

In 2021, the global share of total citations to papers published by Chinese authors (1 953 643: 5 892 128) was 33.16%. The total citations to papers published in China's SCI journals were 124 728, or 2.12% of the global total citations, higher than the percentage of papers published in China's SCI journals to the total papers published globally (1.49%) for the same period.

As shown in table 2.43, there were 12 disciplines in which the percentage of citations of papers published in China's SCI journals to papers published worldwide were greater than or equal to 1.00%, including "materials science" (5.44%), "physics" (5.07%), "geosciences" (4.41%), "chemistry" (3.98%), "plant & animal science" (3.07%), "molecular biology & genetics" (2.81%), "pharmacology & toxicology" (2.31%), "agricultural sciences" (2.05%), "environment/ecology" (1.34%), "engineering" (1.31%), "computer science" (1.21%) and "neuroscience & behavior" (1.19%).

In nine disciplines, the citation rate of papers published by Chinese authors compared to papers in the same discipline published worldwide exceeded 30.00%, including "materials science" (55.30%), "computer science" (51.27%), "engineering" (47.82%), "chemistry" (43.17%), "geosciences" (40.77%), "agricultural sciences" (36.84%), "environment/ecology" (36.27%), "mathematics" (35.13%) and "physics" (34.78%).

For five disciplines, the share of papers from authors from China in China's SCI journals exceeded 90.00%, including "chemistry" (94.26%), "computer science" (94.12%),

TAB. 2.43 – Number of citations of papers published globally/in China's SCI journals/by Chinese authors, in each discipline (2021).

No.	Discipline	Number of citations of papers published globally (A)	Number of citations of papers published in China's SCI Journals (B)	% (B/A × 100%)	Number of citations of papers published by Chinese authors (C)	% (C/A × 100%)	Number of citations of papers published by Chinese authors in China's SCI journals (D)	% (D/C × 100%)	% (D/B × 100%)
1	Agricultural Sciences	177 369	3638	2.05	65 338	36.84	2909	4.45	79.96
2	Biology & Biochemistry	276 886	1496	0.54	67 531	24.39	1349	2.00	90.17
3	Chemistry	698 495	27 813	3.98	301 545	43.17	26 217	8.69	94.26
4	Clinical Medicine	891 685	3320	0.7	132 083	14.81	2565	1.94	77.26
5	Computer Science	191 963	2314	1.21	98 412	51.27	2178	2.21	94.12
6	Economics & Business	93 798	0	0.00	19 279	20.55	0	0.00	—
7	Engineering	800 461	10 458	1.31	382 807	47.82	8105	2.12	77.50
8	Environment/Ecology	363 536	4861	1.34	131 869	36.27	3690	2.80	75.91
9	Geosciences	164 529	7261	4.41	67 082	40.77	5891	8.78	81.13
10	Immunology	144 913	1372	0.95	22 485	15.52	576	2.56	41.98
11	Materials Science	586 859	31 927	5.44	324 552	55.30	27 814	8.57	87.12
12	Mathematics	61 359	610	0.99	21 556	35.13	529	2.45	86.72
13	Microbiology	88 378	289	0.33	14 619	16.54	260	1.78	89.97
14	Molecular Biology & Genetics	191 131	5375	2.81	57 192	29.92	4624	8.09	86.03
15	Multidisciplinary	15 170	60	0.40	1813	11.95	60	3.31	100.00
16	Neuroscience & Behavior	151 486	1805	1.19	20 956	13.83	1006	4.80	55.73
17	Pharmacology & Toxicology	146 544	3390	2.31	38 915	26.56	2743	7.05	80.91
18	Physics	269 453	13 667	5.07	93 711	34.78	11 904	12.70	87.10

Tab. 2.43 – (continued).

No.	Discipline	Number of citations of papers published globally (A)	Number of citations of papers published in China's SCI Journals (B)	% (B/A × 100%)	Number of citations of papers published by Chinese authors (C)	% (C/A × 100%)	Number of citations of papers published by Chinese authors in China's SCI journals (D)	% (D/C × 100%)	% (D/B × 100%)
19	Plant & Animal Science	156 316	4797	3.07	39 104	25.02	3691	9.44	76.94
20	Psychiatry/Psychology	132 198	0	0.00	13 779	10.42	0	0.00	—
21	Social Sciences	231 027	1	0.00	29 574	12.80	1	0.00	100.00
22	Space Science	58 572	274	0.47	9441	16.12	235	2.49	85.77
	Total	5 892 128	124 728	2.12	1 953 643	33.16	106 347	5.44	85.26

Retrieval method – select "research area" in InCites dataset; publication time: 2021; Essential Science Indicators (ESI) as the discipline classification system; literature types: "research papers" and "review articles"; then sequentially retrieve the data of papers published globally, articles published in China's SCI journals, global papers by Chinese authors, and papers published by Chinese authors in China's SCI journals. Ranked in the alphabetical order of disciplines.

"biology & biochemistry" (90.17%), as well as "multidisciplinary" (100%) and "social sciences" (100%).

2.3.1.2.2 Citation Impact

In 2021, the citation impact[7] of papers published in China's SCI journals was 3.56, and the citation impact of papers published by Chinese authors was 3.04, both of which were higher than the citation impact of papers published globally (2.51) in the same period. Compared with 2.82 in 2020, the citation impact of papers published in China's SCI journals increased by 0.74 in 2021, and for the first time, it was higher than the citation impact of papers published by Chinese authors by 0.52.

As shown in table 2.44, from the perspective of the citation impact of papers published by Chinese authors, there were 13 disciplines in which the citation impact of papers published by Chinese authors was higher than the global level of the same discipline, including "agricultural sciences", "chemistry", "computer science", "economics & business", "engineering", "environment/ecology", "geosciences", "materials science", "mathematics", "physics", "plant & animal science", "psychiatry/psychology" and "social sciences". There were 13 disciplines in which the citation impact of papers published in China was higher than the global level in the same discipline, including "agricultural science", "chemistry", "environment/ecology", "geosciences", "immunology", "materials science", "microbiology", "molecular biology & genetics", "multidisciplinary", "neuroscience & behavior", "pharmacology &toxicology", "physics" and "plant & animal science".

Comparing the above two sets of data, for seven disciplines, both the citation impact of papers published by Chinese authors and that of papers published in China's SCI journals were higher than the global level in the same discipline, including "agricultural sciences", "chemistry", "environment/ecology", "geosciences", "materials science", "physics" and "plant & animal science". For disciplines such as "computer science", "economics & business", "engineering", "mathematics", "psychiatry/psychology" and "social sciences", the citation impact of papers published by Chinese authors was higher than the global level in the same discipline, but that of the papers published in China's SCI journals were lower than the global level. For "immunology", "microbiology", "molecular biology & genetics", "multidisciplinary", "neuroscience & behavior", "pharmacology & toxicology", the citation impact of papers published in China's SCI journals was higher than the global level in the same discipline, however, that of papers published by Chinese authors was lower than the global level. The citation impact of papers published in China's SCI journals in the 11 disciplines including "agricultural sciences", "chemistry", "clinical medicine", "immunology", "materials science", "microbiology", "molecular biology & genetics", "multidisciplinary", "neuroscience & behavior", "pharmacology & toxicology", "plant & animal science", were higher than those of papers published by Chinese authors in the same discipline during the same period. China's SCI journals in these above-mentioned 11 disciplines attracted a greater number of high-quality papers.

The citation impact of China's SCI journals for four disciplines exceeded 5.00, including "molecular biology & genetics" (7.66), "immunology" (5.89), "materials science" (5.46) and "multidisciplinary" (5.45).

[7]Citation impact is calculated by total citations for a set of articles divided by the number of all papers. It is used to show the average citations of this set of articles, *i.e.*, the average citation frequency per paper.

TAB. 2.44 – Citation impact of papers published worldwide, by China's SCI journals and by Chinese authors, and percentage of cited papers in each discipline (2021).

No.	Discipline	Citation impact				% Cited papers			
		Papers published worldwide	Papers published in China's SCI journals	Papers published by Chinese authors	Papers published by Chinese authors in China's SCI journals	Papers published worldwide	Papers published in China's SCI journals	Papers published by Chinese authors	Papers published by Chinese authors in China's SCI journals
1	Agricultural Sciences	2.40	3.53	3.09	3.59	64.92	80.87	72.58	81.63
2	Biology & Biochemistry	2.81	2.33	2.62	2.30	68.06	61.93	66.17	60.07
3	Chemistry	3.03	4.27	3.78	4.22	69.46	64.61	71.80	63.68
4	Clinical Medicine	2.15	2.13	1.80	2.10	55.84	58.81	54.72	58.49
5	Computer Science	2.67	2.63	3.29	2.74	58.38	54.38	60.23	54.79
6	Economics & Business	2.09	0.00	2.57	0.00	54.28	0.00	58.47	0.00
7	Engineering	2.87	2.82	3.43	2.77	64.65	64.87	66.02	63.24
8	Environment/Ecology	2.96	3.41	3.85	3.37	68.15	69.35	72.65	68.46
9	Geosciences	2.20	2.58	2.51	2.45	64.09	56.09	64.83	53.67
10	Immunology	3.80	5.89	2.99	4.20	68.70	76.39	67.98	78.10
11	Materials Science	3.57	5.46	4.35	5.50	71.75	72.70	74.60	70.99
12	Mathematics	0.99	0.63	1.28	0.64	38.94	28.57	40.05	28.14
13	Microbiology	2.74	2.86	2.21	2.74	67.22	75.25	64.36	75.79
14	Molecular Biology & Genetics	3.31	7.66	2.80	7.73	68.46	85.33	66.78	84.95
15	Multidisciplinary	4.61	5.45	3.29	5.45	58.49	90.91	56.81	90.91
16	Neuroscience & Behavior	2.30	3.21	1.97	2.83	64.46	79.93	61.62	76.34
17	Pharmacology & Toxicology	2.40	3.91	2.30	3.68	65.05	72.70	65.39	72.08

Tab. 2.44 – (continued).

18	Physics	2.33	2.58	2.51	2.48	61.63	58.27	61.62	56.38
19	Plant & Animal Science	1.59	3.05	2.00	3.36	55.76	69.59	62.03	71.86
20	Psychiatry/Psychology	1.95	0.00	2.05	0.00	55.85	0.00	55.56	0.00
21	Social Sciences	1.55	1.00	2.49	1.00	48.54	100.00	58.53	100.00
22	Space Science	3.26	0.94	3.20	0.96	70.70	47.10	69.11	47.35
	Total	2.51	3.56	3.04	3.54	61.75	64.51	65.26	63.13

Retrieval method – select "research area" in InCites dataset; publication time: 2021; Essential Science Indicators (ESI) as the discipline classification system; literature types: "research papers" and "review articles"; then sequentially retrieve the data of papers published worldwide, articles published in China's SCI journals, global papers by Chinese authors, and papers published by Chinese authors in China's SCI journals.

The data on citation impact and percentage of cited papers of all disciplines used the base value.

Ranked in the alphabetical order of disciplines.

In 2021, the percentage of cited papers published in China's SCI journals was 64.51%, the percentage of cited papers published by Chinese authors was 65.26%, and that of papers published worldwide was 61.75%. It was the first time that the percentage of cited papers published in China's SCI journals outperformed that of papers published worldwide.

The percentage of cited papers published by Chinese authors in 12 disciplines exceeded the global level, including "agricultural sciences", "chemistry", "computer science", "economics & business", "engineering", "environment/ecology", "geosciences", "materials science", "mathematics", "pharmacology & toxicology", "plant & animal science", and "social sciences". The percentage of cited papers published in China's SCI journals in 13 disciplines outperformed the global level in the same discipline, including "agricultural", "clinical medicine", "engineering", "environment/ecology", "immunology", "materials science", "microbiology", "molecular biology & genetics", "multidisciplinary", "neuroscience & behavior", "pharmacology & toxicology", "plant & animal science", and "social sciences". The percentages of cited papers published by Chinese authors in China's STM journals was higher than the global level in seven disciplines, including "agriculture sciences", "engineering", "environment/ecology", "materials science", "pharmacology & toxicology", "plant & animal science" and "social sciences".

2.3.1.2.3 Category Normalized Citation Impact

In 2021, the Category Normalized Citation Impact (CNCI)[8] value of papers published in China's SCI journals was 1.23, and that of Chinese authors was 1.15. Compared with the difference value of the CNCI of papers published in China's SCI journals (1.10) and papers published by Chinese authors (1.25) in 2021, the impact of papers published in China's SCI journals saw a significant increase in 2022.

In terms of the CNCI of papers published by Chinese authors, the impact performance of 13 disciplines was above the world average. Among the disciplines with CNCI < 1, the CNCI of papers published by Chinese authors in "multidisciplinary" was comparatively lower (0.71), followed by "immunology" (0.79). The CNCI of the remaining seven disciplines were close to the world average.

From the perspective of CNCI of papers published in China's SCI journals, the impact of papers in 13 disciplines was above the world average, or CNCI > 1, including "molecular biology & genetics" (2.05), "plant & animal science" (1.84), "pharmacology & toxicology" (1.55), "materials science" (1.46), "agricultural sciences" (1.44), "immunology" (1.39), "chemistry" (1.35), "neuroscience & behavior" (1.22), "multidisciplinary" (1.19), "geosciences" (1.17), "environment/ecology" (1.13), "microbiology" (1.06), and "physics" (1.06); the remaining nine disciplines had CNCI < 1.00, or below the world average, including six disciplines with $0.50 \leq$ CNCI < 1.00, one with $0 <$ CNCI < 0.50, and two with CNCI $= 0$.

The CNCI value of papers published by Chinese authors in China's SCI journals was close to the CNCI of papers published in China's SCI journals, the difference value of the above two CNCIs in 20 disciplines was between $-0.10 - 0.10$, and for both "plant & animal

[8]Category Normalized Citation Impact (CNCI) reflects a paper's citation impact, through the number of citations after its publication. Given the variable rate of citation accrual across disciplines, it is imperative to "normalize" citation counts with respect to categories and publication year prior to calculating the mean citation number. As a reference benchmark, the world average has always been 1.00.

science" and "immunology", the CNCI of papers published by Chinese authors in China's SCI journals was higher than that of papers published in China's SCI journals (by 0.19 and 0.34, respectively).

For "agricultural sciences", "clinical medicine", "materials science", "molecular biology & genetics", "multidisciplinary", and "plant & animal science", CNCI of papers published by Chinese authors in China's SCI journals ≥ CNCI of papers published in China's SCI journals > CNCI of papers published by Chinese authors (figure 2.3).

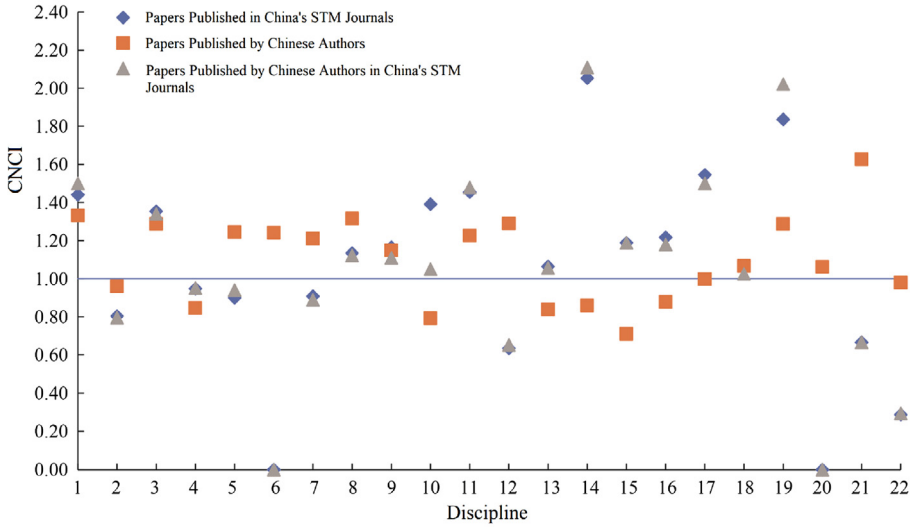

FIG. 2.3 – Comparison of CNCI of papers published in China's SCI Journals, by Chinese authors, and by Chinese authors in China's SCI Journals over all disciplines (2021).

1. Agricultural sciences; 2. Biology & biochemistry; 3. Chemistry; 4. Clinical medicine 5. Computer science; 6. Economics & business*; 7. Engineering; 8. Environment/ecology; 9. Geosciences; 10. Immunology; 11. Materials science; 12. Mathematics; 13. Microbiology; 14. Molecular biology & genetics; 15. Multidisciplinary; 16. Neuroscience & behavior; 17. Pharmacology & toxicology; 18. Physics; 19. Plant & animal science; 20. Psychiatry/psychology**; 21. Social sciences; 22. SpacesScience.

Retrieval method – select "research area" in InCites dataset; publication time: 2021; Essential Science Indicators (ESI) as the discipline classification system; literature types: "research papers" and "review articles"; then sequentially retrieve the data of papers published worldwide, articles published in China's SCI journals, global papers by Chinese authors, and papers published by Chinese authors in China's SCI journals.

*There was no paper published in China's SCI journals in "economics & business", thus for this discipline the CNCI values of papers published in China's SCI journals and by Chinese authors in China's SCI journals were both 0.

**There were no citations from papers in China's SCI journals in the discipline of "psychiatry/psychology". Thus for this discipline, the CNCI values of papers published in China's SCI journals and papers published by Chinese authors in China's SCI journals were both 0.

For 10 disciplines, the CNCI values of papers published by Chinese authors were higher than those of papers published in China's SCI journals. Among them, for "psychiatry/psychology" and "economics & business", the difference between the two values (R) was more than 1.00 ($R > 1.00$); for three disciplines, $0.50 < R \leq 1.00$, and for five disciplines $0 < R \leq 0.50$. On the other hand, there were 12 disciplines where the CNCI values of papers published by China's SCI journals were higher than those of papers published by Chinese authors. Among them, the difference value between the CNCI values was $-0.50 < R \leq 0$ for eight disciplines, $-1.00 < R \leq -0.50$ for three disciplines, and $R \leq -1.00$ for "molecular biology & genetics" (table 2.45).

TAB. 2.45 – D-value of CNCI of papers in each discipline published by Chinese authors and by China's SCI journals in 2021.

No.	Disciplines	D-value (R)
1	Economics & Business	1.24
2	Psychiatry/Psychology	1.06
3	Social Sciences	0.96
4	Space Science	0.69
5	Mathematics	0.65
6	Computer Science	0.34
7	Engineering	0.30
8	Environment/Ecology	0.18
9	Biology & Biochemistry	0.16
10	Physics	0.01
11	Geosciences	−0.02
12	Chemistry	−0.07
13	Clinical Medicine	−0.10
14	Agricultural Sciences	−0.11
15	Microbiology	−0.22
16	Materials Science	−0.23
17	Neuroscience & Behavior	−0.34
18	Multidisciplinary	−0.48
19	Pharmacology & Toxicology	−0.55
20	Plant & Animal Science	−0.55
21	Immunology	−0.60
22	Molecular Biology & Genetics	−1.19

Note: D-value (R) = CNCI of papers published by Chinese authors – CNCI of papers published in China's SCI journals.

2.3.1.2.4 Highly Cited Papers

In 2021, China's SCI journals published 722 highly cited papers,[9] accounting for 3.11% of the total number of highly cited papers worldwide (23 237 papers). Chinese authors published 8838 highly cited papers, accounting for 38.03% of the world's total.

[9]The world's top 1% of papers in each discipline, ranked by number of citations in 2021 (using ESI's discipline categorization).

As shown in table 2.46, the global share of highly cited papers published by Chinese authors exceeded 50% in five disciplines, including "materials science" (71.08%), "computer science" (70.11%), "engineering" (66.06%), "chemistry" (59.14%) and "geosciences" (57.56%). In all disciplines, the percentage of highly cited papers published by Chinese authors relative to the global total was much higher than the percentage of highly cited papers published in China's SCI journals relative to the global total, especially in "mathematics", "computer science and engineering".

The number of highly cited papers in China's SCI journals in "chemistry" topped the list with 167 papers published. Then came "materials science", with 161 papers published. The following 13 disciplines of China's SCI journals whose global share of the highly cited papers exceeded 1% were: "materials science" (9.39%), "geosciences" (9.10%), "chemistry" (7.21%), "physics" (7.12%), "plant & animal science" (6.04%), "molecular biology & genetics" (6.03%), "pharmacology & toxicology" (4.74%), "agricultural sciences" (1.75%), "environment/ecology" (1.68%), "engineering" (1.60%), "computer science" (1.54%), "immunology" (1.07%) and "neuroscience & behavior" (1.04%).

Among all these highly cited papers published in China's STM journals, the proportion of papers published by Chinese authors is high. Among the 16 disciplines that published highly cited papers, 15 disciplines had more than 50.00% of papers from Chinese authors. Among them, all highly cited papers in "biology & biochemistry", "computer science" and "mathematics" were by Chinese authors.

2.3.1.2.5 Number of Papers in Q1 Journals

In 2021, 16 008 papers published by China's SCI journals were Q1 journal papers in JCR, accounting for 1.62% of all Q1 papers published worldwide (989 970 papers) in the same period. Chinese authors published 310 008 papers in Q1 journals, accounting for 31.31% of the world's total. The above 2 ratios are both lower than the global share of highly cited papers.

As shown in table 2.47, there were 12 disciplines in which the percentage of Q1 papers published in China's SCI journals exceeded 1.00%: "physics" (5.24%), "materials science" (3.71%), "molecular biology & genetics" (2.77%), "geosciences" (2.45%), "agricultural sciences" (2.37%), "chemistry" (2.30%), "pharmacology & toxicology" (2.22%), "plant & animal science" (2.18%), "neuroscience & behavior" (1.96%), "multidisciplinary" (1.74%), "immunology" (1.33%) and "engineering" (1.16%). For the remaining 10 disciplines, the rations were less than 1.00%. From the perspective of the author's contribution to China's Q1 journals, Chinese authors had a higher proportion of papers published. Except for the one discipline that had no papers published in Q1 journal in 2021, the rest of the 21 disciplines saw the contribution of Chinese authors more than 50.00%, especially for the disciplines of "microbiology", "multidisciplinary", "psychiatry/psychology", "social sciences", "space sciences", all the papers in Q1 journals were published by Chinese authors.

There were 11 disciplines in which Chinese authors published more than 30.00% of all articles in Q1 journals. They are "materials science" (50.62%), "engineering" (46.32%), "computer science" (44.90%), "geosciences" (40.75%), "chemistry" (38.30%), "molecular biology & genetics" (34.95%), "agricultural sciences" (34.89%), "environment/ecology" (31.98%), "pharmacology & toxicology" (31.90%), "mathematics" (30.40%) and "physics" (30.36%). There was a significant difference between the number of papers published in Q1 journals by Chinese authors and that of papers published in China's Q1 journals, especially

TAB. 2.46 – Number of highly cited papers published worldwide, in China's SCI journals and by Chinese authors, in each discipline (2021).

No.	Discipline	Number of highly cited papers worldwide (A)	Number of highly cited papers published in China's SCI journals (B)	% (B/A × 100%)	Number of highly cited papers published by Chinese authors	% (C/A × 100%)	Ratio of highly cited papers by Chinese authors to those in China's SCI journals (C/B)	Number of highly cited papers published by Chinese authors in China's SCI journals (D)	% (D/B × 100%)
1	Agricultural Sciences	684	12	1.75	300	43.86	25.00	9	75.00
2	Biology & Biochemistry	965	7	0.73	225	23.32	32.14	7	100.00
3	Chemistry	2315	167	7.21	1369	59.14	8.20	162	97.01
4	Clinical Medicine	4063	14	0.34	454	11.17	32.43	12	85.71
5	Computer Science	716	11	1.54	502	70.11	45.64	11	100.00
6	Economics & Business	440	0	0.00	111	25.23	—	0	—
7	Engineering	2805	45	1.60	1853	66.06	41.18	37	82.22
8	Environment/Ecology	1189	20	1.68	534	44.91	26.70	14	70.00
9	Geosciences	714	65	9.10	411	57.56	6.32	52	80.00
10	Immunology	374	4	1.07	35	9.36	8.75	0	0.00
11	Materials Science	1715	161	9.39	1219	71.08	7.57	151	93.79
12	Mathematics	655	6	0.92	314	47.94	52.33	6	100.00
13	Microbiology	313	0	0.00	31	9.90	—	0	—
14	Molecular Biology & Genetics	564	34	6.03	132	23.40	3.88	30	88.24
15	Multidisciplinary	41	0	0.00	4	9.76	—	0	—
16	Neuroscience & Behavior	673	7	1.04	76	11.29	10.86	4	57.14
17	Pharmacology & Toxicology	654	31	4.74	149	22.78	4.81	23	74.19

Tab. 2.46 – (continued).

18	Physics	1095	78	7.12	463	42.28	5.94	69	88.46
19	Plant & Animal Science	993	60	6.04	293	29.51	4.88	48	80.00
20	Psychiatry/Psychology	696	0	0.00	85	12.21	—	0	—
21	Social Sciences	1388	0	0.00	243	17.51	—	0	—
22	Space Science	185	0	0.00	35	18.92	—	0	—
	合计	23 237	722	3.11	8838	38.03	12.24	635	87.95

Retrieval method – select "research area" in InCites dataset; publication time: 2021; Essential Science Indicators (ESI) as the discipline classification system; literature types: "research papers" and "review articles"; then sequentially retrieve the data of papers published worldwide, articles published in China's SCI journals, global papers by Chinese authors, and papers published by Chinese authors in China's SCI journals.

TAB. 2.47 – Number of papers in each discipline in Q1 journals published worldwide, in China's Q1 journals, and by Chinese authors in 2021.

No.	Discipline	Number of papers published in Q1 journals worldwide (A)	Number of papers published in China's Q1 journals (B)	/% ($B/A \times 100\%$)	Number of papers by Chinese authors in Q1 journals (C)	% ($C/A \times 100\%$)	Ratio of number of Q1 papers by Chinese authors to number in China's Q1 journals (C/B)	Number of papers by Chinese authors published in China's Q1 journals (D)	% ($D/B \times 100\%$)
1	Agricultural Sciences	41 703	990	2.37	14 549	34.89	14.70	781	78.89
2	Biology & Biochemistry	45 761	240	0.52	13 039	28.49	54.33	210	87.50
3	Chemistry	107 354	2467	2.30	41 118	38.30	16.67	2290	92.83
4	Clinical Medicine	119 356	663	0.56	14 850	12.44	22.40	527	79.49
5	Computer Science	30 734	282	0.92	13 801	44.90	48.94	249	88.30
6	Economics & Business	17 543	0	0.00	2861	16.31	—	0	—
7	Engineering	122 215	1422	1.16	56 606	46.32	39.81	1094	76.93
8	Environment/Ecology	61 604	499	0.81	19 703	31.98	39.48	382	76.55
9	Geosciences	38 509	942	2.45	15 693	40.75	16.66	673	71.44
10	Immunology	17 580	233	1.33	3351	19.06	14.38	137	58.80
11	Materials Science	96 748	3590	3.71	48 973	50.62	13.64	2970	82.73
12	Mathematics	23 599	54	0.23	7173	30.40	132.83	43	79.63
13	Microbiology	13 010	10	0.08	3451	26.53	345.10	10	100.00
14	Molecular Biology & Genetics	25 318	702	2.77	8849	34.95	12.61	598	85.19
15	Multidisciplinary	631	11	1.74	138	21.87	12.55	11	100.00
16	Neuroscience & Behavior	22 937	449	1.96	3101	13.52	6.91	248	55.23
17	Pharmacology & Toxicology	29 352	653	2.22	9364	31.90	14.34	552	84.53
18	Physics	33 312	1744	5.24	10 114	30.36	5.80	1439	82.51

Tab. 2.47 – (continued).

19	Plant & Animal Science	48 313	1054	2.18	12 595	26.07	11.95	744	70.59
20	Psychiatry/Psychology	27 460	1	0.00	3248	11.83	3248.00	1	100.00
21	Social Sciences	54 309	1	0.00	5468	10.07	5468.00	1	100.00
22	Space Science	12 622	1	0.01	1963	15.55	1963.00	1	100.00
	合计	989 970	16 008	1.62	310 008	31.31	19.37	12 961	80.97

Note: The retrieval method is the same as that of table 2.46.

for the two disciplines of "psychiatry/psychology" and "special science", the difference was more prominent.

2.3.1.3 International Collaborations of Papers Published in China's SCI Journals

In 2021, the share of international collaborations by Chinese authors was 24.23%, which was 3.55% lower than the share of the world's international collaborations in the same period (27.78%). The share of international co-authored papers published in China's SCI journals was 18.81%, which was 8.97% lower than the share of the world's papers international co-authored papers.

As shown in table 2.48, the share of international collaborations by Chinese authors in five disciplines such as "social sciences", "economics & business", "psychiatry and psychology", "computer science" and "space science" was higher than the share of the world's international collaboration papers in the same disciplines. The proportion of international collaborations published in China's SCI journals in six disciplines such as "social sciences", "psychiatry and psychology", "immunology", "plant & animal sciences" and "agricultural sciences" was higher than the proportion of the world's international co-authored papers in the same disciplines. When comparing each discipline, there was not much difference between the percentage of international collaborations by Chinese authors in China's SCI journals and the percentage of international collaborations in China's SCI journals.

2.3.2 International Influence Comparison of Papers Published in China's SCI Journals

Comparing the publication output of 15 countries (or regions) with the largest volume of SCI papers, this section illustrates the main impact indicators (total citation counts, citation impact, percentage of citation, and CNCI) and presents the international competitiveness of China's STM journals from a variety of metrics.

2.3.2.1 Comparison of Academic Influence of Papers Published in STM Journals from Major Countries with the Largest Volume of Paper Output

In 2021, the publication output of 15 countries reached 50 000 papers (as listed in table 2.49). The researchers producing the most STM papers in 2021 were from China; the number of papers published by China's SCI journals ranked fifth; both the citation impact and CNCI of papers published by China's SCI journals ranked first. The number of papers published by American authors ranked second, and the United States ranked first in terms of the number of SCI journals and papers published in these journals, and fourth in terms of both the citation impact and CNCI; the United Kingdom ranked second in terms of the number of SCI journals and papers published in these journals, and third by the number of papers authored by British researchers, as well as the citation impact and CNCI. Germany ranked fourth in terms of the number of SCI journals, the number of papers by German authors and the number of papers published in the same region, fifth in terms of the citation impact, and sixth in terms of CNCI. India ranked sixth for the number of papers published by Indian authors, twelfth for the number of papers published, and fifteenth for both the citation impact and CNCI.

TAB. 2.48 – Percentage of international collaboration papers in each discipline published worldwide, in China's SCI journals and by Chinese authors in 2020.

No.	Discipline	% of int'l collaboration papers published worldwide (A)	% int'l collaboration papers published in China's SCI journals (B)	D-value % ($B - A$)	% of int'l collaboration papers by Chinese authors (C)	D-value % ($C - A$)	% int'l collaboration papers by Chinese authors in China's SCI journals (D)	D-value % ($D - B$)
1	Agricultural Sciences	26.68	27.18	0.50	26.17	−0.51	24.04	−3.14
2	Biology & Biochemistry	28.09	15.91	−12.18	20.23	−7.86	13.65	−2.26
3	Chemistry	24.01	10.77	−13.24	18.23	−5.78	10.01	−0.76
4	Clinical Medicine	22.81	14.09	−8.72	15.98	−6.83	11.48	−2.61
5	Computer Science	32.37	19.57	−12.80	32.83	0.46	19.65	0.08
6	Economics & Business	38.46	0.00	−38.46	46.82	8.36	0.00	0.00
7	Engineering	26.79	21.95	−4.84	25.51	−1.28	20.31	−1.64
8	Environment/Ecology	34.20	24.54	−9.66	31.07	−3.13	22.30	−2.24
9	Geosciences	37.70	20.98	−16.72	34.33	−3.37	18.79	−2.19
10	Immunology	31.03	42.06	11.03	20.48	−10.55	35.77	−6.29
11	Materials Science	25.97	20.04	−5.93	22.03	−3.94	18.76	−1.28
12	Mathematics	31.52	16.14	−15.38	26.25	−5.27	15.10	−1.04
13	Microbiology	31.34	15.84	−15.50	24.64	−6.70	15.79	−0.05
14	Molecular Biology & Genetics	28.31	24.36	−3.95	19.22	−9.09	24.58	0.22
15	Multidisciplinary	31.87	36.36	4.49	30.85	−1.02	36.36	0.00
16	Neuroscience & Behavior	29.38	18.47	−10.91	23.61	−5.77	16.34	−2.13
17	Pharmacology & Toxicology	24.91	16.36	−8.55	14.81	−10.10	15.30	−1.06
18	Physics	30.69	16.41	−14.28	24.92	−5.77	14.67	−1.74

Tab. 2.48 – (continued).

No.	Discipline	% of int'l collaboration papers published worldwide (A)	% int'l collaboration papers published in China's SCI journals (B)	D-value % ($B-A$)	% of int'l collaboration papers by Chinese authors (C)	D-value % ($C-A$)	% int'l collaboration papers by Chinese authors in China's SCI journals (D)	D-value % ($D-B$)
19	Plant & Animal Science	32.82	34.35	1.53	28.91	−3.91	32.97	−1.38
20	Psychiatry/Psychology	28.17	100.00	71.83	36.07	7.90	100.00	0.00
21	Social Sciences	23.59	100.00	76.41	40.77	17.18	100.00	0.00
22	Space Science	57.16	29.01	−28.15	57.25	0.09	27.76	−1.25
	合计	27.78	18.81	−8.97	24.23	−3.55	16.92	−1.89

Note: The retrieval method is the same as that of table 2.46.

For other countries, there was a significant difference between the number of papers published by their authors and the number of papers published by their SCI journals. Canada ranked eighth in terms of the number of papers published by Canadian authors, twelfth and thirteenth in terms of the number of Canada's SCI journals and the corresponding number of papers published, and ninth and eighth in terms of the citation impact and CNCI. The Netherlands ranked fourteenth for the papers published, third both in terms of the number of journals and papers published, and second both in terms of the citation impact and CNCI.

The top five countries by the number of SCI journals were: the United States (4425), the United Kingdom (3042), the Netherlands (982), Germany (796) and Japan (254). China ranked sixth with 232 SCI journals having CN code. In terms of the ratio of the number of papers published in one country's SCI journals to the number of papers published by authors from that country, there were three countries which had a higher number of papers published in their native journals than that by their native authors (ratio > 1). They are the Netherlands (4.32), the United Kingdom (3.91), and the United States (1.45). There were eight countries in which the ratio was lower than 20.00%: China (0.05), Spain (0.07), Iran (0.10), India (0.10), Canada (0.11), Australia (0.13), Italy (0.16), and Republic of Korea (0.18).

1) Top three countries by the citation impact: China (3.56), the Netherlands (3.06) and the United Kingdom (2.82).
2) Top three countries by percentage of papers cited: the Netherlands (68.58%), the United Kingdom (64.79%) and China (64.51%).
3) Top four countries with CNCI value > 1 (*i.e.*, higher than the disciplinary average): China (1.23), the Netherlands (1.19), the United Kingdom (1.12) and the United States (1.10).

In 2021, the 11 countries with more than 1000 highly cited papers published by their native authors were China (8838), the United States (7612), the United Kingdom (3118), Germany (2294), Australia (1895), Italy (1853), Canada (1643), France (1467), Spain (1346), India (1333), and the Netherlands (1188) in descending order. The four countries with over 1000 highly-cited papers published in their native SCI journals were the United States (8628), the United Kingdom (6854), the Netherlands (2999) and Germany (1156). The number of highly-cited papers published in SCI journals in the Netherlands, the United Kingdom, and the United States was higher than the number of papers published by their native authors (table 2.50).

2.3.2.2 High-Impact Papers Published in China's SCI Journals in 2021

In 2021, 232 China's SCI Journals published 112 highly cited papers (48.28%); among them, 44 journals published hot papers (18.97%). 11 journals published more than 20 highly-cited papers, all of which were English-language journals: *Journal of Energy Chemistry* ranked first (76), *Nano-Micro Letter* ranked second (41) and *Bioactive Materials* (40) ranked third, as shown in table 2.51.

Tab. 2.49 – Impacts in all disciplines for 15 largest paper-producing countries in 2021.

No.	Country	Number of journals	Number of papers published by native author(s) (A)	Number of papers published by native journals (B)	Ratio (B/A)	Total citation counts (C)	Citation impact (C/B)	Percentage of cited papers	CNCI
1	China	232	642 391	35 045	0.05	124 728	3.56	64.51	1.23
2	United States	4425	510 909	739 657	1.45	1 973 398	2.67	61.98	1.10
3	United Kingdom	3042	149 167	582 630	3.91	1 640 785	2.82	64.79	1.12
4	Germany	796	147 853	119 622	0.81	290 361	2.43	60.22	0.90
5	India	99	117 913	12 349	0.10	8154	0.66	31.50	0.28
6	Italy	122	105 457	17 364	0.16	34 392	1.98	53.35	0.90
7	Japan	254	102 291	25 138	0.25	28 426	1.13	47.35	0.48
8	Canada	121	96 518	11 070	0.11	17 006	1.54	52.29	0.75
9	Australia	156	95 000	12 576	0.13	19 376	1.54	51.42	0.73
10	France	190	92 826	20 427	0.22	43 636	2.14	57.64	0.85
11	Spain	126	88 054	6336	0.07	6193	0.98	35.12	0.52
12	Republic of Korea	144	83 452	15 165	0.18	22 181	1.46	51.20	0.57
13	Brazil	119	68 359	13 987	0.20	13 113	0.94	37.40	0.38
14	Netherlands	982	56 202	242 662	4.32	741 522	3.06	68.58	1.19
15	Iran	41	53 804	5512	0.10	5117	0.93	38.44	0.39

Note – select "Research Areas" in the InCites dataset; publication time: 2021; Essential Science Indicators (ESI) as the discipline classification system; literature types: "research papers" and "review articles"; then sequentially retrieve the authors, and papers published in SCI journals from different countries.

Ranked in descending order by the number of papers published by native authors from each country.

TAB. 2.50 – Number of highly-cited papers published by native authors and journals in all disciplines for 15 largest paper-producing countries in 2021.

No.	Country	Highly-cited papers published by native authors (A)		Highly-cited papers published in native journals (B)		Ratio (B/A)
		Number of papers	Ranking	Number of papers	Ranking	
1	China	8838	1	722	5	0.08
2	United States	7612	2	8628	1	1.13
3	United Kingdom	3118	3	6854	2	2.20
4	Germany	2294	4	1156	4	0.50
5	India	1333	10	10	14	0.01
6	Italy	1853	6	153	7	0.08
7	Japan	942	13	41	11	0.04
8	Canada	1643	7	57	9	0.03
9	Australia	1895	5	53	10	0.03
10	France	1467	8	161	6	0.11
11	Spain	1346	9	26	12	0.02
12	Republic of Korea	962	12	61	8	0.06
13	Brazil	615	15	19	13	0.03
14	Netherlands	1188	11	2999	3	2.52
15	Iran	809	14	9	15	0.01

Note: The retrieval method is the same as that of table 2.49.

TAB. 2.51 – China's SCI journals with more than 20 highly-cited papers published in 2021 (all were English language papers).

No.	Journal title (ENG)	Journal title (CHN)	Number of highly-cited papers
1	*Journal of Energy Chemistry*	能源化学 (英文)	76
2	*Nano-Micro Letters*	纳微快报 (英文)	41
3	*Bioactive Materials*	生物活性材料 (英文)	40
4	*Journal of Materials Science & Technology*	材料科学技术 (英文版)	38
5	*Chinese Chemical Letters*	中国化学快报 (英文版)	30
6	*Molecular Plant*	分子植物 (英文)	28
6	*Chinese Journal of Catalysis*	催化学报 (英文)	28
8	*Signal Transduction and Targeted Therapy*	信号转导与靶向治疗 (英文)	26
9	*Geoscience Frontiers*	地学前缘 (英文版)	25
10	*Light: Science & Applications*	光: 科学与应用 (英文)	23
11	*Acta Pharmaceutica Sinica B*	药学学报 (英文)	21

Note: Ranked in descending order by the number of highly-cited papers.

2.3.2.3 International Collaborations of Papers in China's SCI Journals

2.3.2.3.1 China's International Collaborations with 14 Largest SCI Paper-Producing Countries

In 2021, China's 232 SCI journals all published papers with international co-authors from the largest SCI paper-producing countries. From the perspective of the number of international collaborations, 222 of China's SCI journals coauthored the most papers with authors from the United States, followed by the United Kingdom, Australia, Germany, Canada and Japan. From the perspective of citations, the percentage of cited papers co-authored with authors from the above countries was higher than the average of China's SCI journals (64.51%). The top five countries with the highest percentage of cited papers were Australia (81.26%), Iran (81.25%), Spain (80.88%), India (80.10%) and Brazil (79.66%). All CNCI values of international collaborations were above 1, and countries with CNCI > 2 were India (2.57), Australia (2.31), Iran (2.31), the Republic of Korea (2.29), Spain (2.24), the Netherlands (2.24), Brazil (2.15) and Japan (2.07) (as shown in table 2.52).

Tab. 2.52 – China's international collaborations with the top 14 SCI papers produced countries/regions.

No.	Country/region	Number of China's STM journals involved international collaborations	Number of international collaborations	Times cited	% Papers cited	CNCI
1	United States	222	2252	11 781	78.06	1.86
2	United Kingdom	173	668	3638	76.80	1.81
3	Australia	165	747	5147	81.26	2.31
4	Germany	151	637	3373	78.49	1.90
5	Canada	146	413	2200	74.09	1.83
6	Japan	138	424	2640	77.12	2.07
7	France	115	351	1519	75.78	1.65
8	Italy	105	234	1171	74.79	1.89
9	South Korea	99	245	1593	79.59	2.29
10	Spain	87	204	1074	80.88	2.24
11	India	85	196	1408	80.10	2.57
11	Netherlands	85	170	972	77.65	2.24
13	Iran	69	176	1108	81.25	2.31
14	Brazil	65	118	634	79.66	2.15

Note – select "Publication Resources" in the InCites dataset; publication time: 2021; Essential Science Indicators (ESI) as the discipline classification system; literature types: "research papers" and "review articles"; then sequentially retrieve the data of international collaborations of China's SCI journals with each country.

2.3.2.3.2 Number of Papers with International Collaborations in China's SCI Journals and Their Citation Performance

In 2021, 6592 international co-authorship papers were published in China's 232 SCI journals. The number of such papers published in each journal ranged from 1 to 292. The top ten journals with the largest number of international co-authorship papers were *Journal of Materials Science & Technology* (292), *Journal of Energy Chemistry* (241), *Nano Research* (182), *Geoscience Frontiers* (111), *Chinese Chemical Letters* (101), *npj Computational Materials* (96), *Bioactive Materials* (95), *Photonics Research* (95), *National Science Review* (94), *Science Bulletin* (86), and *Chinese Physics B* (86), as listed in table 2.53.

The top ten journals ranked by the percentage of international co-authored papers published were *Fungal Diversity* (92.59%), *Journal of Systematics and Evolution* (65.79%), *Bone Research* (56.25%), *Geoscience Frontiers* (55.50%), *Infectious Diseases of Poverty* (51.22%), *International Soil and Water Conservation Research* (50.00%), *National Science Review* (49.21%), *Molecular Plant* (47.54%), *npj Computational Materials* (46.83%), and *Pedosphere* (46.51%) (see table 2.54).

China's top ten SCI journals in terms of the citation impact of international co-authored papers were *Nano-Micro Letters* (18.2), *InfoMat* (17.81), *Signal Transduction and Targeted Therapy* (16.68), *National Science Review* (14.24), *Computational Visual Media* (13.36), *Acta Physico-Chimica Sinica* (13.18), *Electrochemical Energy Reviews* (11.86), *Bioactive Materials* (11.85), *Asian Journal of Pharmaceutical Sciences* (11.82), and *Journal of Energy Chemistry* (11.75), as shown in table 2.55.

There were 109 of China's SCI journals with international co-authorship papers that were above the world average (CNCI > 1). The top ten journals ranked by their CNCI values were *Molecular Plant* (5.75), *Fungal Diversity* (5.68), *National Science Review* (5.32), *International Journal of Mining Science and Technology* (4.85), *Geoscience*

Tab. 2.53 – China's top 10 SCI journals by number of international co-authored papers in 2021 (all were English language journals).

No.	Journal title (ENG)	Journal title (CHN)	Number of international co-authored papers
1	*Journal of Materials Science & Technology*	材料科学技术 (英文版)	292
2	*Journal of Energy Chemistry*	能源化学 (英文)	241
3	*Nano Research*	纳米研究 (英文版)	182
4	*Geoscience Frontiers*	地学前缘 (英文版)	111
5	*Chinese Chemical Letters*	中国化学快报 (英文版)	101
6	*npj Computational Materials*	计算材料学	96
7	*Bioactive Materials*	生物活性材料 (英文)	95
7	*Photonics Research*	光子学研究 (英文)	95
9	*National Science Review*	国家科学评论 (英文)	94
10	*Science Bulletin*	科学通报 (英文版)	86
10	*Chinese Physics B*	中国物理B (英文)	86

Note: Ranked in descending order of the number of international co-authored papers.

TAB. 2.54 – China's top 10 SCI journals s by the percentage of international co-authored papers published in 2021 (all were English language journals).

No.	Journal title (ENG)	Journal title (CHN)	Language	% of international co-authored papers published
1	*Fungal Diversity*	真菌多样性 (英文)	English	92.59
2	*Journal of Systematics and Evolution*	植物分类学报	English	65.79
3	*Bone Research*	骨研究 (英文)	English	56.25
4	*Geoscience Frontiers*	地学前缘 (英文版)	English	55.50
5	*Infectious Diseases Of Poverty*	贫困所致传染病 (英文)	English	51.22
6	*International Soil and Water Conservation Research*	国际水土保持研究 (英文)	English	50.00
7	*National Science Review*	国家科学评论 (英文)	English	49.21
8	*Molecular Plant*	分子植物 (英文)	English	47.54
9	*npj Computational Materials*	计算材料学	English	46.83
10	*Pedosphere*	土壤圈 (英文版)	English	46.51

Note: Ranked in descending order of the percentage of international co-authorship papers.

TAB. 2.55 – China's top 10 SCI journals in terms of the citation impact of international co-authorship papers in 2021.

No.	Journal title (ENG)	Journal title (CHN)	Language	Citation impact of international co-authorship papers
1	*Nano-Micro Letters*	纳微快报 (英文)	English	18.20
2	*InfoMat*	信息材料 (英文)	English	17.81
3	*Signal Transduction and Targeted Therapy*	信号转导与靶向治疗 (英文)	English	16.68
4	*National Science Review*	国家科学评论 (英文)	English	14.24
5	*Computational Visual Media*	计算可视媒体 (英文)	English	13.36
6	*Acta Physico-Chimica Sinica*	物理化学学报	Chinese	13.18
7	*Electrochemical Energy Reviews*	电化学能源评论 (英文)	English	11.86
8	*Bioactive Materials*	生物活性材料 (英文)	English	11.85
9	*Asian Journal of Pharmaceutical Sciences*	亚洲药物制剂科学 (英文)	English	11.82
10	*Journal of Energy Chemistry*	能源化学 (英文)	English	11.75

Note: Ranked in descending order of the citation impact of international co-authorship papers.

Frontiers (4.75), *Nano-Micro Letters* (4.38), *Asian Journal of Pharmaceutical Sciences* (4.29), *Signal Transduction and Targeted Therapy* (4.00), *InfoMat* (3.90), and *Light: Science & Applications* (3.75), as listed in table 2.56.

TAB. 2.56 – China's top 10 SCI journals for CNCI of international co-authorship papers in 2021 (all were English language journals).

No.	Journal title (ENG)	Journal title (CHN)	Language	CNCI
1	*Molecular Plant*	分子植物 (英文)	English	5.75
2	*Fungal Diversity*	真菌多样性 (英文)	English	5.68
3	*National Science Review*	国家科学评论 (英文)	English	5.32
4	*International Journal of Mining Science and Technology*	矿业科学技术学报 (英文)	English	4.85
5	*Geoscience Frontiers*	地学前缘 (英文版)	English	4.75
6	*Nano-Micro Letters*	纳微快报 (英文)	English	4.38
7	*Asian Journal of Pharmaceutical Sciences*	亚洲药物制剂科学 (英文)	English	4.29
8	*Signal Transduction and Targeted Therapy*	信号转导与靶向治疗 (英文)	English	4.00
9	*InfoMat*	信息材料 (英文)	English	3.90
10	*Light: Science & Applications*	光: 科学与应用 (英文)	English	3.75

Note: Ranked in descending order of CNCI values of international co-authorship papers.

2.3.2.4 Annual Reviews of Papers Published in China's SCI Journals

In 2021, 35 045 papers were published in 232 SCI journals from China. The number of each ranged from 27 to 1085 papers. Tables 2.57–2.62 separately lists the top ten journals

TAB. 2.57 – China's top 10 SCI journals by the number of papers published in 2021.

序号	Journal title (ENG)	Journal title (CHN)	Language	Number of papers
1	*Chinese Physics B*	中国物理B (英文)	English	1085
2	*Journal of Materials Science & Technology*	材料科学技术 (英文版)	English	996
3	*Acta Physica Sinica*	物理学报	Chinese	937
4	*Journal of Energy Chemistry*	能源化学 (英文)	English	928
5	*Nano Research*	纳米研究 (英文版)	English	755
6	*Chinese Chemical Letters*	中国化学快报 (英文版)	English	743
7	*Spectroscopy and Spectral Analysis*	光谱学与光谱分析	Chinese	628
8	*Rare Metal Materials and Engineering*	稀有金属材料与工程	Chinese	600
9	*Chinese Journal of Chemistry*	中国化学 (英文)	English	450
10	*Chinese Journal of Organic Chemistry*	有机化学	Chinese	422

Note: Ranked in descending order of the number of papers published by each journal.

Tab. 2.58 – China's top 10 SCI journals by citation counts in 2021 (all were English language journals).

No.	Journal title (ENG)	Journal title (CHN)	Citation counts
1	*Journal of Energy Chemistry*	能源化学 (英文)	10 098
2	*Journal of Materials Science & Technology*	材料科学技术 (英文版)	8515
3	*Bioactive Materials*	生物活性材料 (英文)	5075
4	*Chinese Chemical Letters*	中国化学快报 (英文版)	4508
5	*Nano-Micro Letters*	纳微快报 (英文)	4009
6	*Nano Research*	纳米研究 (英文版)	3474
7	*Chinese Journal of Catalysis*	催化学报 (英文)	3276
8	*Signal Transduction and Targeted Therapy*	信号转导与靶向治疗 (英文)	3210
9	*Journal of Environmental Sciences*	环境科学学报 (英文版)	2127
10	*National Science Review*	国家科学评论 (英文)	2087

Note: Ranked in descending order of the citation counts of papers published by each journal.

Tab. 2.59 – China's top 10 SCI journals by citation impact in 2021 (all were English language journals).

No.	Journal title (ENG)	Journal title (CHN)	Citation impact
1	*Nano-Micro Letters*	纳微快报 (英文)	19.65
2	*Chinese Journal of Catalysis*	催化学报 (英文)	15.75
3	*Signal Transduction and Targeted Therapy*	信号转导与靶向治疗 (英文)	14.66
4	*Bioactive Materials*	生物活性材料 (英文)	14.46
5	*InfoMat*	信息材料 (英文)	12.98
6	*Cell Research*	细胞研究 (英文版)	11.94
7	*Electrochemical Energy Reviews*	电化学能源评论 (英文)	11.59
8	*National Science Review*	国家科学评论 (英文)	10.93
9	*Journal of Energy Chemistry*	能源化学 (英文)	10.88
10	*Fungal Diversity*	真菌多样性 (英文)	10.26

Note: Ranked in descending order of the citation impact of papers published by each journal.

ranked by the number of papers, citation counts, citation impact, percentage of papers cited, CNCI, and journal impact factors (JIF).

2.3.2.5 Papers Authored by Chinese Researchers Worldwide

From 2012 to 2021, 4 399 639 Chinese researchers[10] published 3 567 419 papers worldwide, accounting for 20.63% of the global share, including 45 369 highly cited papers, or 26.28%.

In terms of the number of highly cited papers published in the past ten years, Guangming Zengfrom Hunan University topped the list with 213 papers; eight Chinese

[10]The researchers may be repeat count, in which each different ways that the name were written counted as one.

TAB. 2.60 – China's top 10 SCI journals by percentage of papers cited in 2021 (all were English language journals).

No.	Journal title (ENG)	Journal title (CHN)	Language	% of papers cited
1	*Bioactive Materials*	生物活性材料 (英文)	English	98.86
2	*Journal of Magnesium and Alloys*	镁合金学报 (英文)	English	98.10
3	*Nano-Micro Letters*	纳微快报 (英文)	English	98.04
4	*Chinese Journal of Catalysis*	催化学报 (英文)	English	97.60
5	*Electrochemical Energy Reviews*	电化学能源评论 (英文)	English	96.88
6	*Molecular Plant*	分子植物 (英文)	English	96.72
7	*Environmental Science and Ecotechnology*	环境科学与生态技术 (英文)	English	96.55
8	*Fungal Diversity*	真菌多样性 (英文)	English	96.30
9	*InfoMat*	信息材料 (英文)	English	96.25
10	*Bone Research*	骨研究 (英文)	English	95.83

Note: Ranked in descending order of the percentage of papers cited in each journal.

TAB. 2.61 – China's top 10 SCI journals by CNCI value in 2021 (all were English language journals).

No.	Journal title (ENG)	Journal title (CHN)	Language	CNCI
1	*Fungal Diversity*	真菌多样性 (英文)	English	6.05
2	*Molecular Plant*	分子植物 (英文)	English	5.66
3	*Chinese Journal of Catalysis*	催化学报 (英文)	English	5.38
4	*Nano-Micro Letters*	纳微快报 (英文)	English	4.99
5	*International Journal of Mining Science and Technology*	矿业科学技术学 (英文)	English	4.21
6	*Geoscience Frontiers*	地学前缘 (英文版)	English	4.09
7	*Cell Research*	细胞研究 (英文版)	English	3.90
8	*National Science Review*	国家科学评论 (英文)	English	3.88
9	*Light: Science & Applications*	光: 科学与应用 (英文)	English	3.86
10	*Journal of Integrative Plant Biology*	植物学报 (英文版)	English	3.79

Note: Ranked in descending order of the CNCI value of each journal.

TAB. 2.62 – China's top 10 SCI journals by JIF in 2021 (all were English language journals).

No.	Journal title (ENG)	Journal title (CHN)	JIF
1	*Cell Research*	细胞研究 (英文版)	46.38
2	*Signal Transduction and Targeted Therapy*	信号转导与靶向治疗 (英文)	38.13
3	*Military Medical Research*	军事医学研究 (英文)	34.92
4	*Electrochemical Energy Reviews*	电化学能源评论 (英文)	32.80
5	*Fungal Diversity*	真菌多样性 (英文)	24.90
5	*International Journal of Oral Science*	国际口腔科学杂志	24.90
7	*InfoMat*	信息材料 (英文)	24.80
8	*Nano-Micro Letters*	纳微快报 (英文)	23.66
9	*National Science Review*	国家科学评论 (英文)	23.18
10	*Cellular & Molecular Immunology*	中国免疫学杂志 (英文版)	22.10

Note: Ranked in descending order of JIF.

TAB. 2.63 – Top 30 researchers from China by the number of highly cited papers, with information on papers published, citations, and percentage of highly cited papers from 2012 to 2021.

No.	Researcher's name (ENG)	Researcher's name (CHN)	Affiliation	Number of papers	Citation counts	Number of highly cited papers	% of highly cited papers
1	Guangming Zeng	曾光明	Hunan University	1266	89 627	213	16.82
2	Qiang Zhang	张　强	Tsinghua University	763	82 236	166	21.76
3	Zhonglin Wang	王中林	Beijing Institute of Nanoenergy and Nanosystems, CAS	1192	109 723	151	12.67
4	Jiaguo Yu	余家国	Wuhan University of Technology	432	77 211	138	31.94
5	Yuming Chu	褚玉明	Huzhou University, Changsha University of Science & Technology	617	12 097	136	22.04
6	Wei Huang	黄　维	Nanjing Tech University, Nanjing University of Posts and Telecommunications, Northwestern Polytechnical University	2115	87 198	120	5.67
7	Lin Gu	谷　林	Institute of Physics, CAS; University of CAS	800	55 617	117	14.63
8	Yadong Li	李亚栋	Tsinghua University	365	42 788	116	31.78
9	Han Zhang	张　晗	Shenzhen University	617	38 497	105	17.02
10	Jinde Cao	曹进德	Southeast University	1000	31 543	94	9.40
11	Lirong Zheng	郑黎荣	Institute of High Energy Physics, CAS; University of CAS	594	35 328	92	15.49
12	Danlian Huang	黄丹莲	Hunan University	257	21 734	91	35.41
13	Shuhong Yu	俞书宏	Hefei Institutes of Physical Science, CAS; University of CAS	441	47 682	84	19.05
14	Dingsheng Wang	王定胜	Tsinghua University	246	23 192	79	32.11
15	Zhuang Liu	刘　庄	Suzhou University	366	46 075	79	21.58
16	Yi Xie	谢　毅	Hefei Institutes of Physical Science, CAS; University of CAS	391	46 459	78	19.95
17	Jianhui Hou	侯剑辉	Institute of Chemistry, CAS; University of CAS	356	41 076	73	20.51
18	Huiming Cheng	成会明	Institute of Metal Research, CAS; University of CAS	397	47 199	73	18.39
19	Bei Cheng	程　蓓	Wuhan University of Technology	183	26 721	69	37.70

Tab. 2.63 – (continued).

20	Shaocheng Tong	佟绍成	Liaoning University of Technology	272	19 912	69	25.37
21	Jun Chen	陈　军	Nankai University	352	38 803	65	18.47
22	Yongfang Li	李永舫	Institute of Chemistry, CAS; University of CAS	538	43 292	65	12.08
23	Tao Zhang	张　涛	CAS; University of CAS; Dalian Institute of Chemical Physics, CAS	1052	44 098	64	6.08
24	Min Cheng	程　敏	Hunan University	147	13 894	62	42.18
25	Xiangke Wang	王祥科	North China Electric Power University	319	24 844	62	19.44
26	Tierui Zhang	张铁锐	Technical Institute of Physics and Chemistry, CAS; University of CAS	186	23 088	61	32.80
27	Xinchen Wang	王心晨	Fuzhou University	242	36 289	61	25.21
28	Jun Wang	王　俊	Beijing Institute of Genomics, CAS	312	68 247	61	19.55
29	Xuping Sun	孙旭平	University of Electronic Science and Technology of China	196	12 776	60	30.61
30	Hailong Jiang	江海龙	Fujian Institute of Research on the Structure, CAS; University of CAS	131	22 932	59	45.04
30	Feiyu Kang	康飞宇	Tsinghua University	715	39 969	59	8.25

Note – select "Researchers" in InCites dataset; publication time: 2012–2021; Essential Science Indicators (ESI) as the discipline classification system; literature types: "research papers" and "review articles"; then sequentially retrieve the data of Chinese researchers.
There were two researchers ranked 30th by the number of highly cited papers.
Disambiguation has been performed to all researchers' name, and the data in the table were analyzed from the results of name disambiguation. Each researcher's one paper counts 1.
Ranked in descending order of the number of highly cited papers published by each author.

researchers published more than 100 highly cited papers, including Academician Qiang Zhang from Tsinghua University with 166 papers, Academician Zhonglin Wang, Beijing Institute of Nanoenergy and Nanosystems, Chinese Academy of Sciences, with 151 papers, Prof. Jiaguo Yu, Wuhan University of Technology, with 138 papers, Prof. Yuming Chu, Huzhou University and Changsha University of Science & Technology, 136 papers, Prof. Wei Huang, Nanjing Tech University, Nanjing University of Posts and Telecommunications and Northwestern Polytechnical University, 120 papers; Prof. Lin Gu, Institute of Physics, Chinese Academy of Sciences, 117 papers; Academician Yadong Li, Tsinghua University, with 116 papers; and Prof. Han Zhang, Shenzhen University, with 105 papers (table 2.63).

In terms of the percentage of highly cited papers, Prof. Hailong Jiang, Fujian Institute of Research on the Structure, Chinese Academy of Sciences, and Prof. Min Cheng, Hunan University ranked in the top two, occupying 45.04% and 42.18% respectively; of seven scholars exceeded 30.00%, ranking in the top three to top nine: Prof. Bei Cheng, Wuhan University of Technology, 37.70%; Prof. Dan Huang, Hunan University, 35.41%; Tierui Zhang, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, 32.80%; Dingsheng Wang, Tsinghua University, 32.11%; Jiaguo Yu, Wuhan University of Technology, 31.94%; Yadong Li, Tsinghua University, 31.78; and Xuping Sun, University of Electronic Science and Technology of China, 30.61%.

Reference

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Chapter 3

Open Publishing Status of Chinese Science and Technology Journals

Xiaomin LIU, Na MA, Xian XIAO and Ran MI

Abstract

The open publishing of China's STM journals has its own characteristics. On one hand, journal editors want to benefit the vast number of scholars in China and practice open publishing, but on the other hand, they face challenges of updated digital publishing technology and insufficient internet dissemination capabilities. Therefore, China's STM journals, especially Chinese language ones, have launched their own solutions, such as operating the journals' website by themselves to make free access to the full text of papers and relying on dissemination channels from external platforms to provide full-text on pay-per-view basis; thus creating a publishing model in which open access goes parallel with subscription for the same journal.

The open publishing models for China's STM journals present a diversified development, covering various models such as gold/diamond OA, hybrid OA, and bronze OA. Journals adopting the bronze OA publishing model represented the highest proportion (875 journals, accounting for 80.42%), followed by gold/diamond OA (131 journals, accounting for 12.04%), and relatively few journals adopted the hybrid OA publishing model (82 journals, accounting for 7.54%). Hybrid OA journals were mainly hosted by large international publishers. By August 2022, among 1262 CSCD-indexed journals, 1088 adopted various OA models, accounting for 86.21%. Among them, English journals were more likely to adopt OA, with 234 accounting for 95.51% of the 245 indexed English journals; while 854 Chinese OA journals accounted for 83.97% of the 1017 indexed Chinese journals.

Open publishing is an important part of open science. Open science makes the scientific process more transparent, is an important way to bridge the gap in science, technology and innovation, and helps to narrow the digital technology and knowledge gap between and within countries. Chinese science and technology journals are involved in the

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global open-access movement, and actively carry out open-publishing research and put it into practice.

3.1 Analysis of the Open Publishing Mode of Chinese Science and Technology Journals

The open publishing of Chinese science and technology journals has the characteristics of China. On the one hand, the editorial department of journals hopes to benefit the majority of domestic scholars and practice open publishing; on the other hand, it is faced with the challenge of digital publishing technology updates and insufficient Internet communication ability. Therefore, science and technology journals in China, especially Chinese science and technology journals, have launched their own solutions, forming a mode of self-running journal websites, practicing free access to full text, relying on external platform communication channels to provide paid full text, and opening a parallel publishing mode of open access and journal subscription. The self-generating motivation from journals, the policy guidance from the competent and host departments, and the open science promotion consortium led by the China Association for Science and Technology are bound to promote the continuous exploration and improvement of the open publication of Chinese science and technology journals.

3.1.1 Open Publishing Mode of Science and Technology Journals in China

The development of open publishing of science and technology journals in China requires practice and exploration, and the practices of excellent journals provide examples for reference. In order to objectively show the status and characteristics of the open publishing of high-quality Chinese science and technology journals, in this section, the Chinese Science Citation Database (CSCD) is selected to analyze the open publishing status of Chinese science and technology journals.

As of August 2022, there were 1262 CSCD source journals, and 1088 journals adopted different OA publishing modes, accounting for 86.21% of the total source journals. Among them, more English journals adopt an open publishing mode, with 234 English OA journals, accounting for 95.51% of source English journals (245) and 854 Chinese OA journals, accounting for 83.97% of source Chinese journals (1017). The open publishing mode of Chinese science and technology journals shows diversified development, covering various open-access modes such as golden OA/diamond OA, mixed OA, bronze OA and so on. Bronze OA is where the editorial department directly opens free full-text access to the paper after publication. The journals using the bronze OA publishing mode account for the highest proportion (875, accounting for 80.42%), followed by golden OA/diamond OA (131, accounting for 12.04%), and relatively few journals using a mixed OA publishing mode (82, accounting for 7.54%). Hybrid OA journals rely mainly on large international publishers.

From the perspective of disciplines, the proportion of open-publishing journals in all disciplines is over 80% (table 3.1), among which environmental science is the discipline

Tab. 3.1 – Publishing mode and proportion of OA journals of various disciplines in China, 2022.

No.	Discipline	Golden OA/diamond OA	Mixed OA	Bronze OA	OA journal quantity/number	Discipline journal quantity/number	OA journal proportion/%
1	Environmental Science	1	2	28	31	32	96.88
2	Agricultural Science	12	1	88	101	107	94.39
3	Physics	3	5	25	33	35	94.29
4	Geoscience	10	13	102	125	135	92.59
5	Bioscience	14	7	46	67	73	91.78
6	Chemistry	2	4	18	24	27	88.89
7	Comprehensive Discipline	5	3	54	62	70	88.57
8	Mechanics	3	3	12	18	21	85.71
9	General Theory of Social Sciences	3	1	14	18	21	85.71
10	Mathematics	2	7	17	26	31	83.87
11	Medical Science	31	10	200	241	289	83.39
12	Engineering	45	26	271	342	421	81.24
13	Total	131	82	875	1088	1262	86.21

Note: Sort by the proportion of OA journals.

with the highest proportion of open-publishing journals (96.88%), and engineering technology is the discipline with the lowest proportion of open publishing journals (81.24%). In total, the proportion of open journals in 7 disciplines was higher than that of all open journals (86.21%), namely environmental science, agricultural science, physics, earth science, biological science, chemistry and comprehensive journals, and the proportion of 5 disciplines was lower than that of all open journals, namely mechanics, General social science, mathematics, medicine and engineering technology. Bronze OA mode is the most selected open publishing mode in various disciplines, and 90.32% of OA journals in environmental science choose Bronze OA mode, followed by agricultural science, comprehensive journals, medical journals and earth science journals.

3.1.2 Rules for Open Publication of Science and Technology Journals in China

Under the open publishing mode of Chinese science and technology journals dominated by bronze OA, there are 231 journals following the international Creative Commons license agreement (CC BY 4.0), accounting for only 21.23% of the total OA journals (1088 kinds). 77.85% of OA journals (847) still require authors to sign a copyright transfer agreement to transfer the author's compilation rights (part or all of the paper), translation rights, print and electronic reproduction rights, distribution rights and network communication rights to the editorial department of the journal. The editorial department of *the Chinese Science* series (0.92%) has defined the citation authorization license by itself. If it needs to use the content of the publication again, it needs to apply for the relevant authorization of the editorial department of the journal.

From the perspective of journal languages, 187 of 234 OA English journals follow relevant international open publishing agreements according to cooperative publishers or relevant international rules, accounting for 79.91%; only 44 of 854 OA Chinese journals follow open publishing agreements, accounting for 5.15%. There is still room for further improvement of Chinese journals following international open-access agreements. 803 Chinese journals (94.03%) still follow the copyright transfer agreement mode under the order mode, while the other 7 journals define reference licenses by themselves.

The status of Chinese OA journals following the CC BY agreement is shown in table 3.2. CC BY 4.0 indicates that the journal only follows the CC BY agreement and does not specify the details of the agreement. In terms of quantity, CC BY-NC-ND is the most frequently selected OA license agreement of the journal, which allows users to copy, distribute, exhibit, show, broadcast or disseminate to the public through the information network for non-profit purposes, but the author's signature must be retained and not performed during use. Some journals allow authors to choose from two agreements, CCBY or CC BY-NC-ND. CC BY-NC-SA is one of the less selected open access agreements for Chinese science and technology journals.

Tab. 3.2 – Situation that Chinese OA journals follow the CC BY agreement.

Agreement	Journal quantity/number	Abbreviation and meaning of the key elements included
CC BY 4.0	117	Follow the CC agreement
CC BY-NC-ND	95	BY, Attribution-NC, Noncommercial-ND, No Derivative Works
CC BY	60	BY, Attribution
CC BY-NC	27	BY, Attribution-NC, Noncommercial
CC BY-NC-SA	3	BY, Attribution-NC, Noncommercial-SA, Share Alike

3.1.3 Characteristics of Open Publishing of Chinese Science and Technology Journals

Although the open access rules followed by Chinese science and technology journals, especially journals in Chinese, have certain Chinese characteristics, the openness of journals in Chinese should not be underestimated. According to the survey, in the 1088 OA journals, nearly 40% of journals' OA goes back to 2000, and some go back to the founding year. PDF format papers can be directly obtained, or the full text can be directly read online, on the website of the journal editorial department. The longest OA retrospective time is of the *Chinese Medical Journal*, dating back to 1887, showing the centennial development history of this journal.

Figure 3.1 shows the distribution of the open backtracking years of OA journals in China. On the whole, there are three small peaks in the distribution, from 1950 to 1955,

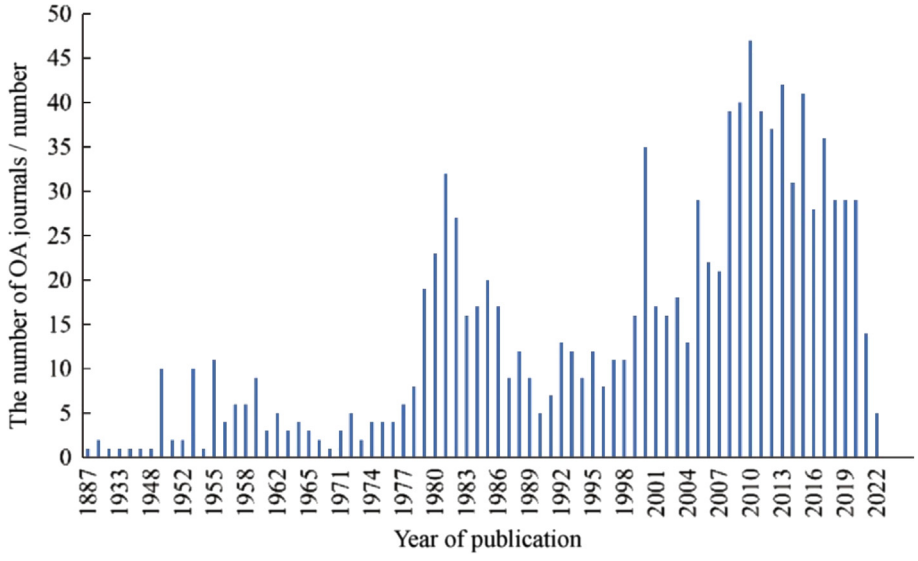

Fig. 3.1 – Distribution of the open backtracking years of OA journals in China from 1887 to 2022.

1979 to 1986 and 2005 to 2020. In 2002, the Budapest Open Access Initiative was signed and gradually popularized in China, and the journal industry responded positively, thus forming 2005 as the most active starting point for open publishing.

The number of open publishing science and technology journals in each region of China in 2022 is shown in table 3.3. The top five regions are Beijing (502), Shanghai (87), Jiangsu (61), Sichuan (48) and Shaanxi (45).

Tab. 3.3 – Number of OA science and technology journals in each region of China, 2022.

No.	Region	OA science and technology journal quantity/number	No.	Region	OA science and technology journal quantity/number
1	Beijing	502	16	Shandong	16
2	Shanghai	87	17	Henan	15
3	Jiangsu	61	18	Anhui	12
4	Sichuan	48	19	Fujian	11
5	Shaanxi	45	20	Shanxi	8
6	Hubei	41	21	Hebei	7
7	Liaoning	32	22	Yunnan	6
8	Guangdong	31	23	Xinjiang	5
9	Zhejiang	28	24	Guangxi	4
10	Tianjin	24	25	Guizhou	4
11	Chongqing	22	26	Hainan	1
12	Hunan	20	27	Jiangxi	1
13	Heilongjiang	19	28	Inner Mongolia	1
14	Jilin	19	29	Qinghai	1
15	Gansu	17		Total	1088

From the distribution of competent organizations of 1088 Chinese OA science and technology journals, the competent organizations with the largest number of OA journals are China Association for Science and Technology (262), Chinese Academy of Sciences (214), Ministry of Education (189), National Health Commission (35), Ministry of Agriculture and Rural Affairs (19), Ministry of Industry and Information Technology (17), China North Industries Group Co., Ltd. (11), China Earthquake Administration (10), State Oceanic Administration (9) and Department of Natural Resources (9).

Article Processing Charge (APC) is one of the OA journal operation funding sources. Due to the management system and related policies and regulations, the vast majority of the journal operation has not really realized market operation, whose funding still comes from government input. Although some journals explicitly illustrate the APC, the APC price mode and charging principle still need institutional guarantee and in-depth research in journal OA policy, to support our science and technology journals to play an important role in promoting academic exchanges and social development.

3.2 Analysis of the Open Publishing Status of International Publishers' Cooperative Journals

Under the trend of global open science, the cooperation between English journals and international publishers in China has entered a new stage of open publishing. Not only the newly established journals adopt the OA mode, but also some subscription journals that have been running for many years and are renowned in the academic field are also gradually switching to the OA mode in cooperation with international publishers. Due to their own characteristics and different cooperative publishers, these cooperative journals also show some differences in the open publishing mode and publishing rules.

3.2.1 The Open Publishing Mode of Cooperation Between Science and Technology Journals and International Publishers in China

3.2.1.1 Characteristics of the Open Publishing Mode

In the environment of increasingly open journal publishing mode, most of the Chinese journals that cooperate with international publishers are complete or mixed OA journals, and only a few journals provide the paid subscription publishing mode.

The English journals funded by The Excellent Action Plan for Chinese Science and Technology Journals occupy an important place in the development of science and technology journals in China. In order to generate international influence as soon as possible and develop communication channels, the vast majority of these journals cooperate with international publishers and adopt an open publishing and subscription mode to provide reading services, including 147 OA journals and 4 subscription mode journals. In the OA mode, gold OA/diamond OA journals are the most frequent (71), followed by mixed OA journals (62) and the least bronze OA journals (14). The publishing mode of diamond OA is where the authors, institutions or funders do not pay the open publishing fees, but the publisher pays all the expenses incurred during the publishing process. According to the current situation, the journal expenses of diamond OA in China mainly come from government funds. Golden OA is when the article processing charge is paid by the author, institution or funder, the paper is open immediately, and readers will no longer pay for it. Among them, *Acta Mathematica Sinica, English Series*, *Acta Mathematicae Applicatae Sinica, English Series*, *Chinese Annals of Mathematics, Series B* and *Frontiers of Mathematics in China*, in collaboration with Springer Nature, adopt the subscription mode.

Most of the journals published in cooperation with international publishers in the golden OA and mixed OA mode have a certain influence in their academic field and are also leading in the field of journal publishing, actively practicing and exploring new OA publishing operation modes. Journals such as the *National Science Review* and the *Chinese Journal of Aeronautics* are typical representatives of golden OA. *National Science Review* adopted an OA mode at its inception, and the APC of the original paper was clearly marked. The price of APC also increased year by year, which was $1904 per piece in 2022. *Chinese Journal of Aeronautics* is a professional academic journal running for many years, and it has unique characteristics in the discipline field. In 2022, its APC was $2000 per

piece, which exceeded the average APC of Elsevier's Golden OA journal. *Cell Research*, *Molecular Plant*, *Chinese Astronomy and Astrophysics* and others are representatives of mixed OA journals. *Cell Research* takes an APC of £3060 for a single paper, which exceeds the average APC of mixed OA journals in Springer. From 2021 to 2022, among all the new journals jointly founded by China and Elsevier, only one new journal adopted a fully paid subscription mode, and the rest are gold or diamond OA journals. The only one using paid subscription mode will shift to a full OA mode in 2023[1]. In addition, all journals of KeAi, jointly established by China Science and Technology Publishing & Media Co., Ltd. and Elsevier adopt the golden or diamond OA mode. Under the trend of open science, the proportion of gold or diamond OA publishing in Chinese journals cooperating with international publishers will be further increased.

3.2.1.2 Open Publishing Ownership of Journals

In terms of ownership, OA journals cooperated between China and international publishers adopt two ways: complete ownership by domestic institutions and joint ownership between domestic institutions and international publishers.

In the early stage of cooperative publishing, the ownership of journals was vague. Some scholars in the field of academic journals believe that Chinese academic institutions only need to grasp the dominant power of editors in cooperating with foreign institutions, and whether the ownership is completely independent is not the main issue. Recently, the fifth round of discipline evaluation requirements of the Ministry of Education clearly explained that "Chinese academic journals" must be fully owned by Chinese academic institutions[1]. Therefore, in recent years, Chinese journals increasingly prefer to have exclusive ownership when cooperating with international publishers. However, for some Chinese academic journal publishing institutions with little experience in English journals, English journals rely more on the operation and publicity of international publishers at the early stage of their establishment, and they will still choose to conduct in-depth cooperation with international publishers in the form of shared ownership. With the continuous improvement of journal quality, Chinese academic publishing institutions may consider repurchasing the ownership of journals from international publishers after the stable development period, which can also reflect the self-management of journals[1].

Take the academic journal cooperated with Wiley as an example. As hybrid OA journals which were founded and published by China and then signed a cooperative publishing agreement with Wiley after a period of time, *Acta Geologica Sinica, English Edition* and *Insect Science* are exclusively owned by the two Chinese institutions of *the Geological Society of China* and *the Institute of Zoology, Chinese Academy of Sciences*, respectively. The ownership of the *Chinese Journal of Chemistry* journal is shared by *the Chinese Chemical Society* and Wiley (50% each). At present, among the OA journals that China cooperates with Wiley, about two-thirds of the cooperative journals are exclusively owned by Chinese institutions, and another one-third of the journals' ownership is shared by both parties.

Digital publishing has broken the traditional publishing pattern of academic journals. The publishing industry is paying full attention to copyright protection. How to maximize

[1] https://www.sciencedirect.com/journal/chinese-journal-of-analytical-chemistry/about/aims-and-scope.

the promotion of academic journals to safeguard their legitimate rights and interests, give full play to the rights of the work compilation subject of academic journals as well as fully respect and protect the copyright of the works in open publishing, international cooperation and academic exchanges, and provide better services in the digital environment, still need more attention and discussion in the industry.

3.2.2 Open Publishing Rules and Article Processing Charge

The main international partners of Chinese science and technology journals are Elsevier, Springer Nature, Wiley, Taylor-Francis and other well-known publishing groups. These publishing groups have made detailed provisions on open publishing licensing agreements, the use of different versions of papers, copyright ownership, and details of APC prices and discounts. Chinese journals basically follow the corresponding terms of partners. Summarizing the rules of the four major publishing groups, although each has its own characteristics, the core elements remain unchanged.

3.2.2.1 License Agreement

OA papers from the four major publishers are usually published under the CC 4.0 Creative Commons license, with most journals offering the most open CC BY Creative Commons license. In addition, the four publishers have some special provisions for the OA licensing agreement.

Springer Nature's license agreement is relatively straightforward, with most journals offering OA options using the CC BY Creative Commons license, and a few journals, including Adis, using CC BY-NC as the default Creative Commons license. Springer Nature also allows authors to change the shared license for paper use after the publication of the OA paper, but only from a stringent one to a more relaxed and standardized one.

OA papers in Elsevier's journals may currently achieve open access through CC BY, CC BY-NC-ND, CC BY-NC and Elsevier user licenses, among which the most common ones are CC BY, CC BY-NC-ND and Elsevier user licenses. The OA permission of Elsevier user license[2] is stricter than that of CC BY-NC-ND. Other users are not allowed to publish papers in places like repositories, nor to use some contents or excerpts of the paper for secondary creation. The sharing and self-storage of green OA papers and accepted manuscripts require adherence to the CC BY-NC-ND protocol. Free contents in the Elsevier Open Archive need to be used under the Elsevier user license.

Wiley's journals mainly provide three Creative Commons licenses: CC BY, CC BY-NC and CC BY-NC-ND. However, a few journals whose full ownership is owned by academic societies do not support CC license agreements, and the academic societies of these journals have different policies for OA. These OA papers without a Creative Commons license are copyrighted on the Wiley platform but may be used in the following ways[3]: Individual users may access, download, copy, display and distribute OA papers to colleagues for non-commercial and non-promotional purposes, and may adapt, translate and mine the

[2] https://www.elsevier.com/about/policies/open-access-licenses/elsevier-user-license.

[3] https://authorservices.wiley.com/author-resources/Journal-Authors/licensing/onlineopen-without-a-creative-commonslicense.html.

text and data content of the papers, provided that the moral rights of the authors are not infringed. These rights include the right of authorship and integrity, and the use of Wiley OA papers for commercial purposes, such as commercial, promotional or marketing purposes, requires additional permission from Wile and payment of a fee.

Taylor-Francis' journals also provide three Creative Commons[4] for OA papers: CC BY, CC BY-NC and CC BY-NC-ND, but each journal will only provide 1 to 2 Creative Commons licenses for authors to choose from.

3.2.2.2 Sharing Rules

From submission to final publication, papers usually go through multiple versions of the author's original manuscript, the final accepted manuscript, and a journal paper officially published. Different versions of papers need to follow different sharing rules, and the sharing rules will vary depending on the choice of OA (golden OA) or paid subscription (green OA) for publication.

The sharing rules for the author's original manuscript (AOM), the accepted manuscript (AM), and the version of record (VOR) need to be clarified. All four publishing groups allow authors to share preprints or original manuscripts at any time, stressing that pre-prints cannot be deliberately added or enhanced in any way to look more like or enough to replace the final version of the paper. The original manuscript published on the pre-print platform before submission will not be regarded as repeated publication, and will not affect the acceptance of the papers by the editorial department of the journal. However, it is recommended that the author attach a DOI link to the official published text in the previously published preprint and the original manuscript after the paper is accepted by the journal and officially published. This will help readers of preprints and original manuscripts link to find, access, read and cite the best version of the paper.

The accepted version has different sharing rules depending on whether the paper is OA. There is generally no limit to the sharing time of accepted OA papers, while green OA papers with a paid subscription are usually shared after a lag period. The lag period varies from publisher to publisher, ranging from 6 to 36 months. Since OA papers can be directly shared in officially published versions, the accepted manuscript-sharing rules of the four major publishers are mainly for green OA papers with paid subscriptions. For green OA papers, publishers support the authors to share the accepted manuscript in the blog and team, but sharing in the institutional repository must follow the time regulation of the lag period and give the link to the publisher's official version[5].

The official version uses the sharing rules that distinguish the golden OA and subscription mode. For non-OA papers, the officially published text of the paper should not be publicly published unless agreed with the publisher. If the PDF version of the paper published through the golden OA channel is stored in the institutional repository or other appropriate discipline repository, the author needs to provide a DOI link to the publisher's web page URL when the backup is stored and attach a written description with the publisher's name.

[4] https://authorservices.taylorandfrancis.com/.

[5] https://www.elsevier.com/open-access.

3.2.2.3 Article Processing Charge

The Article Processing Charge (APC) is an indispensable part of the current open publishing. No matter whether APC is charged or the pricing of APC, all major publishers have given clear policies, with detailed explanations on the cost of each journal, and the different application times of APC and APC in different types of literature. According to the statistics, the APC of mixed OA journals in China is higher than the APC of golden OA journals, which is consistent with the characteristics of international publishing.

Major publishers have also developed some APC discount programs, including OA business agreements with research institutions and universities, journal payment agreements, association membership discounts, and author APC discounts[6] for OA papers in low-and middle-income countries (LMICs). When OA papers meet several discounts simultaneously, publishers generally rate them at the highest discount. Five institutions in China, namely, Academy of Military Medical Sciences, Chinese Academy of Medical Sciences, Chinese Academy of Sciences, Institute of Parasitic Diseases, Chinese Center for Disease Control and Prevention, and Shenzhen Beike Biotechnology, have joined the BMC Journal membership program[7] of Springer Nature. In addition to the Chinese Academy of Sciences, four other institutions have also joined the SpringerOpen program[8]. Researchers at these institutions receive APC discounts when publishing OA papers in journals covered by Springer Nature's corresponding program. All publishers have clear APC discount rules for LMICs, which partly addresses the problem of the digital divide.

3.2.3 Typical Cases of Open Publishing

3.2.3.1 National Science Review

National Science Review (NSR) is a comprehensive scientific journal run by the Chinese Academy of Sciences, sponsored by the Science Press and published in cooperation with Oxford University Press (OUP). Founded in 2014, NSR aims to report on the cutting-edge development of science and technology in China and around the world. Research papers cover all fields of natural science, including physics, mathematics, chemistry, life science, materials science and information science, consisting of columns such as Review, Research Article and Perspective. NSR started as a hybrid OA journal, hosted electronically by the HighWire digital publishing platform and open to the world's scientific community[9].

In 2017, with OUP's technology partnership with the new digital platform, NSR began running the SilverChair platform for hosting and publishing the online version of the journal's papers[2]. In 2018, the journal was changed to online publishing[10]

[6] https://www.elsevier.com/connect/authors-update/a-helping-hand-with-your-open-access-journey.

[7] https://www.biomedcentral.com/about/institutional-support/membership.

[8] https://www.springeropen.com/about/institutional-support/membership.

[9] http://www.bjb.cas.cn/jcdt2016/201506/t20150626_4379962.html.

[10] https://academic.oup.com/pages/what-we-publish/journal-title-lists/changes-to-journals-lists-by-year#2014.

only, and all manuscripts will implement the advanced online publishing mode of "paper is published upon acceptance". In 2020, it became a full OA journal, and all published papers will be golden OA papers. In 2021, NSR changed from a page code system to a paper code system, and a fixed reference relationship can be formed after the paper is published online. At present, all published papers are available for free reading.

The journal publicity is also undertaken by Science Press in collaboration with OUP. The Science Press publishes Chinese references of NSR papers on the self-developed Sci-Engine platform and promotes their papers to the authors of NSR paper references. OUP is responsible for NSR's overseas publicity work, promoting NSR papers on the official blog, Twitter and Facebook platforms[2].

By default, journals achieve open access under the CC BY Creative Commons license, with the authors retaining the copyright and granting the publisher a non-exclusive publishing license. In accordance with the OUP's policy for paper self-archiving, authors may at any time publish the original manuscript on the personal homepage, institutional or non-commercial repository, commercial websites or repository, social media, and publish the officially published text of the paper at any place immediately after publication. The publisher recommends that authors replace the previously published version of the paper with an officially published text to ensure that the reader has access to the final version of the paper and has the paper correctly cited. Authors should also store their original URLs while storing official published papers in other repositories. Anyone publishing, disseminating and secondary using journal papers need to explicitly indicate the NSR and OUP as the original source of the paper and provide the correct citation information.

As NSR is a full OA journal, APC is required for paper publication. In 2022, the journal APC was $1904. Papers published in the four columns of Perspective, Brief Communication, Review and Research Article need to pay the APC in full, and the other columns do not need to pay the APC.

NSR has continuously enhanced its ability for positive development through cooperation with internationally renowned academic publishing institutions. Since its inception, the number of journal publications and its academic influence have been increasing. In the beginning, it was a quarterly journal, and from 2014 to 2016, it published $80 \sim 100$ articles per year. In 2017, it changed to a bimonthly journal, and the annual number of published articles has increased year by year, reaching 199 articles in 2019. In 2020, it was changed to a monthly publication and the number of annual articles further increased. In 2021, the number of articles reached 278. NSR was included in the SCI database in the second year of its inception (June 2015), and the first JCR impact factor was 8.000. The latest impact factor released in 2022 has reached 23.178, ranking 4th among 73 multidisciplinary comprehensive journals included in SCI, second only to *Nature*, *Science* and *Nature Human Behaviour*. In addition, NSR was also selected for the "China International Impact Promotion Plan of Science and Technology Journals" (Class II) and "China Excellent Action Plan of Science and Technology Journals" (Leading Journal), and won the fifth "China Publishing Government Award, Journal Award" in 2021, which has become one of the excellent practices of establishing international first-class science and technology journals in China.

3.2.3.2 Molecular Plant

Founded in 2008, *Molecular Plant* (MP) is supervised by the Chinese Academy of Sciences, and co-sponsored[11] by the Center of Excellence for Molecular Plant Science, Chinese Academy of Sciences, Institute of Plant Physiology and Ecology, Chinese Academy of Sciences and the Chinese Society of Plant Physiology and Plant Molecular Biology. The journal focuses on botany, covering cell biology, physiology, biochemistry, molecular biology, genetics, development, plant-microbial interaction, genomics, bioinformatics and molecular evolution, with columns of original research papers, reviews, communication and focus.

At its inception, MP worked with OUP and adopted a paid subscription publishing mode. OUP was responsible for journal publication and also used the HighWire digital publishing platform to publish papers. In 2014, MP ended its cooperation with OUP and signed a cooperation agreement with Cell Press, becoming the publisher's first cooperative journal in Asia[3]. Since 2015, Cell Press has become the new publisher of MP, responsible for the global publishing of journals, and MP has joined Elsevier. Elsevier shares the best papers of the journal by email and publishes 2–3 special issues every year to publicize it to global readers and help to enhance the international voice and influence of the journal[12].

Currently, MP has changed to a mixed OA journal, allowing authors to publish through paid subscriptions or OA modes. Papers published by paid subscription modes can have open access through green OA. The OA option applies to all research papers and some types of non-research papers[13]. For OA papers, authors may choose to achieve open access under either CC BY or CC BY-NC-ND. However, once selected, the author cannot revoke or change the selected Creative Commons license.

According to Elsevier and Cell Press, authors can publish the preprint of the paper and the original manuscript anytime, anywhere, with a statement and a link to the official release of the journal. Papers published on the paid subscription mode can share the accepted version in accordance with Elsevier regulations, after the lag period of 12 months after official publication[14]. OA papers can share the official published text under the selected Creative Commons license. Green OA papers can only be freely accessible to officially published papers within 50 days by sharing the shared link provided by Cell Press.

The MP charges $2200 for each published research report, research paper, resource paper, and review paper. For OA papers, MP will charge an additional APC. The standard is $3000 per standard paper and $1500 per short paper.

The MP requires authors to grant exclusive copyright license worldwide to the journal editorial department, including: ① publish the final paper on MP; ② distribute and (or) disseminate to the public with the journal, individually or with other relevant materials, in a printed, electronic, or any other format or medium (whether known or later designed); ③ authorize and license a third party to do any of the above acts; ④ store copies of the paper in Cell Press or its authorized third party online repository.

[11] https://www.cas.cn/cm/202012/t20201217_4771048.shtml?from=timeline.

[12] https://www.elsevier.com/zh-cn/strategic-partners/journal-partnerships/molecular-plant.

[13] https://www.cell.com/open-access.

[14] https://www.cell.com/rights-sharing-embargoes.

In addition, MP has some submission and storage requirements for the experimental materials and data in the paper. The corresponding author is required to fill out a list of the materials, data sets, codes and protocols used in the manuscript before acceptance of the final manuscript[15]. After the official publication of the paper, these datasets must be immediately and freely available to readers. As for large-scale datasets and data such as protein sequences, and biological macromolecular structures, the full dataset must be submitted to the designated public repository. For example, the protein sequence data needs to be stored in the Uniport platform. The DNA/RNA sequence shall be stored in one of several platforms: Genbank/European Nucleotide Archive (ENA)/DDBJ, Protein DataBank, UniProt, and National Genomics Data Center. The atomic coordinates and relevant experimental data of biological macromolecular structures should be stored in the member sites of the global protein database. Besides, in addition to the data that must be stored, the journal also encourages the author to store the compound structure, proteomics data, protein interaction data, compound screening and analysis data, flow cytometer data and other data in the corresponding public repository, in order to provide other researchers and realize the open sharing of the paper related data.

At present, MP is published monthly, with an annual publication volume of about 200, and OA papers account for about 20%. Under the strict evaluation of the editorial department and the unremitting publicity of the publisher, the academic influence has been continuously enhanced. It was included in SCI when it was founded. In 2009, the influence factor was 2.784, and it entered the botanical Q1 area and biochemistry and molecular biology Q2 area. After that, the impact factor and the ranking rose steadily. The latest impact factor published in 2022 has reached 21.949, ranking 3rd among 238 SCI journals in Botany and 6th among 296 SCI journals in Biochemistry and Molecular Biology. MP is a world-class top science and technology journal jointly created by China and international publishers.

3.3 New Challenges in the Open Publication of Chinese Science and Technology Journals

3.3.1 International Open Publishing Trends

Since the Budapest Open Access Initiative in 2002, open access has entered a substantial stage of development. All kinds of people in the scientific community are involved. Driven by a series of action plans, journal publishers implement open access to journals, adopt diversified publishing modes, including golden OA, mixed OA, diamond OA, bronze OA, etc., and support green OA. Science and technology journals are important platforms for academic exchange and play an important role in the open science movement. With the development of open science movement, the open publishing has also changed accordingly, adapting to the changes in science and its scientific research activities and creating new value.

[15] https://www.cell.com/molecular-plant/authors.

3.3.1.1 Distribution Characteristics of Global Open-Publishing Journals

The number of international open-publishing journals is on a steady rise. According to the statistics of the Directory of Open Access Journals (DOAJ) website, as of July 2022, there are 18 058 OA journals registered[16] in the DOAJ database, including 9637 journals in the natural science field, accounting for 22.41% of the global natural science journals (more than 43 000).

More than 7.79 million OA papers were collected on the DOAJ website, including more than 5.79 million papers in the field of natural sciences. In terms of the number of OA journals, the number of natural science and humanities and social science journals is almost equal. In terms of the number of OA papers, the number of OA papers in the natural science field is much more than that in the field of humanities and social science.

There were only 21 OA journals registered in the DOAJ database in 2002, and after 20 years of development, OA journals have formed a certain scale. The number of OA journals grew the fastest in 2008, 2010 and 2013, which all grew by nearly 50% from the previous year. Since 2017, the number of OA journals has increased to about 1000 annually, entering a period of steady growth. The 9637 journals come from 100 countries, covering both developed and developing countries, including some countries with less developed economies. The UK ranked first with 1627 OA journals, followed by Indonesia and the United States with 830 and 679 journals respectively (table 3.4).

Tab. 3.4 – Number of OA science and technology journals by country, 2022 (TOP10).

No.	Country	OA journal quantity/number
1	The United Kingdom	1627
2	Indonesia	830
3	The United States	679
4	Brazil	596
5	Iran	506
6	Switzerland	451
7	Poland	358
8	India	305
9	Holland	298
10	Russia	288

Note: Sort by the number of OA journals.

As can be seen from the subject distribution of 9637 OA science and technology journals (table 3.5), the number of OA journals in the medical field is far ahead of other disciplines with 4009 journals, 1.4 times that of 2772 journals in basic science and 1.8 times that of 2242 journals in the industrial technology field. There are 798 journals in agricultural science and 622 journals in geographical science. Among the more than 5.79 million OA papers, there are more than 2.74 million papers from the medical field, accounting for 47.32%, and more than 2.06 million papers in the field of basic science,

[16] http://doaj.org.

Tab. 3.5 – Published papers of OA journals in different disciplines worldwide, 2022.

Discipline	OA journal quantity/number	Paper quantity/number	Average number of papers per journal/number
Basic Science	2772	2 067 147	745.72
Medical Science	4009	2 748 687	685.63
Industrial Technology	2242	1 200 797	535.59
Agricultural Science	798	379 298	475.31
Geoscience	622	273 536	439.77

Note: Sort by the average number of papers per journal.

accounting for 35.58%. The above two disciplines make up the majority of open publishing. The average number of papers per journal is 745.7 in basic sciences and 685.6 in the medical field. Compared with traditional journals, the large number of papers has become a feature of OA journals.

From the perspective of publishers, Elsevier is one of the main practitioners of open-publishing journals, ranking first with 593 OA journals. The four major international publishing groups are all actively practicing the open publication of journals, and the publishers with more than 100 OA journals are listed in table 3.6.

The paper use license agreement for open publishing journals essentially follows the CC license. The majority of the 9637 OA journals adopted CC BY, at 5642. There are 2117 journals using CC BY-NC-ND, 826 journals using CC BY-NC-SA, 151 journals using CC BY-ND, 489 journals using CCBY-SA, 267 journals using CC0 and 143 journals where the publishers themselves define Creative Commons license. Two journals indicate that the adoption of a public open policy CC license provides a legal guarantee for the development of journal open publishing. However, in the process of journal publishing, the authors are relatively passive and can only use the rules suggested by the submitted journals, and cannot choose according to their own wishes.

Tab. 3.6 – Publishers worldwide and the number of their OA journals, 2022 (100+).

Publisher	OA journal quantity/number
Elsevier	593
BMC	304
MDPI	276
Wolters Kluwer Medknow Publications	224
Wiley	217
Hindawi Limited	214
SAGE Publishing	158
Taylor & Francis	154
SpringerOpen	150
Sciendo	116
Frontier	103

Note: Sort by the number of OA journals.

3.3.1.2 Open Peer Review and Paper Data Sharing

After 20 years of development, open publishing has become an integral part of scientific research activities, as illustrated by the growing number of OA journals. Open publishing is not only reflected in the change of paper access mode, but also has new developments in peer review and paper-associated data. Among the 9637 OA journals, they adopt not only double-blind and single-blind peer-review but also open peer-review (156 journals) and post-publication peer-review (6 journals). The 65 journals published by BMC adopt the open peer-review mode. BMC is not only the pioneer of open publishing journals, but also actively trying to open peer review, which is more in line with the concept of open science. Although there are 156 open peer-reviewed journals, only accounting for 1.62% of the total number of OA science and technology journals, they involve 61 publishers/journal editorial departments. Except for BMC, the number of open peer-reviewed journals of other publishers is only in the single digits, reflecting that journals are cautious about new attempts in the publishing process.

Scientific data as important as academic papers is of high importance to publishers. Since the publication of the first scientific data journal by Nature Publishing Group in 2014, some journals with scientific data as the main content have been published in a relatively short period of time, but there has been no explosive and continuous growth. However, as an important research basis for science and technology papers, the data is increasingly paid attention to by publishers. The associated data of a paper is not only an important support for the research results in the paper, but also a proof of the authenticity of conclusions. It provides the data basis for the verification and repeatability of the results and plays a certain role in the integrity of scientific research. Publishers actively promote the submission, storage and utilization of the associated data of papers. *Science*, *Nature*, *Cell* and other well-known journals have forced authors to submit relevant data at the time of submitting papers. Elsevier and Springer Nature recommend and encourage authors to submit associated data for their papers. The associated data can be stored in a publicly shared data storage platform, or submitted as an attachment to the paper. The author may specify the use of the data in the paper, including public use, delayed use, etc.

While cooperating with data storage platforms in international general or professional disciplines, publishers have also developed corresponding data storage platforms themselves. Elsevier developed the Mendeley Data[17] platform for the global storage of associated data, which enables researchers to make their research data public, allowing other researchers to reuse it, and increasing the reproducibility, transparency, and trust of the original study. Publishers have made new practices in the association, and storage of scientific data and links between papers and data.

3.3.1.3 Open Publishing Journal Services

International journal publishing modes are diversified, and digital publishing and digital publishing-based services are constantly presented. The fragmented structure of digital publishing provides a basis for the deepening of services. The structured text of data

[17] https://data.mendeley.com/.

publishing not only marks the title, author, organization, abstracts and charts of the paper but also deepens the methods, software, data and other contents adopted by the paper. The structure of the original paper "goal, method, result and conclusion" has basically formed a formula for a long time. In original papers, "method" is the most valuable part of scientific research and is the foundation of scientific research stringency. To strengthen the outstanding role of methodology in scientific research and provide more methodological details with a greater emphasis on transparency, and responsible initiatives in open science, in 2016, *Cell* launched a new set of methodological templates, STAR Methods (Structured, Transparent, Accessible and accessible Reporting). So far, *Cell* and 13 of its sub journals have required authors to use STAR Methods templates[18] to write their methodology sections. As its name suggests, STAR Methods has attracted the attention of users and is becoming a "star".

From the perspective of paper discovery and utilization, Elsevier provides a series of services. Open full-text access API to users to support text mining for non-commercial purposes; provide unstructured text retrieval to find suitable journals for authors. Searching any keyword in the full text scans all the literature being published by Elsevier, providing great convenience for readers to find information. Publishers are providing more perfect service tools for authors and readers based on content.

3.3.2 Challenges and Opportunities Faced by the Open Publishing of Science and Technology Journals in China

In November 2021, the General Assembly of UNESCO deliberated and adopted the Open Science Proposal, marking a new stage of global consensus about open science. The Open Science Proposal defines the common values, principles and standards of open science at the international level, and proposes a series of actions that are conducive to the fair and equitable implementation of open science for all at the individual, institutional, national, regional and international levels. Countries responded positively to UNESCO's recommendations. In order to promote the in-depth practice of open science in China and the world, in May 2022, the China Association for Science and Technology initiated the establishment of the Open Science Promotion Consortium, inviting domestic and foreign institutions with important influence in related fields such as open access, open data, and open science infrastructure construction to join, in order to build consensus and synergy, as well as explore feasible plans for creating an innovation ecology in which scientific and technological resources are shared, and industry, education, research and application are coordinated. After nearly ten years of development, China's science and technology journals have realized the transformation from printed publishing to a combination of digital and printed publishing. The vast majority of Chinese journals provide services in the bronze OA mode. Some English journals that cooperate with international publishers adopt the golden OA mode, and some others adopt the diamond OA mode. The funding source of the diamond OA mode is mostly the investment of government funds. In terms of the rapid growth of international open-publishing journals and related services, the open publishing of science and technology journals in China is facing new challenges.

[18] https://www.cell.com/star-authors-guide.

3.3.2.1 Policy Construction and Publishing Ethics are the Cornerstone of Open Publishing Development

The construction of open publishing series policies is the cornerstone for the steady and orderly development of science and technology journal open publishing in China. At present, the open publishing mode in China is a bottom-up choice to follow the changes in international publishing forms from the perspective of industry development. The uneven open publishing standards adopted by journals, the lack of technical standards for open publishing, the adoption of international relevant instructions without clear descriptions and binding terms on copyright, use rights and interests, and the interests of journal publishing relevant parties, as well as the lack of application and review mechanism for online publishing, have slowed down the pace of digital publishing of journals to a certain extent.

Noise has also appeared in the development process of international open publishing, mainly manifested in the emergence of predatory journals for profit. The publishers of these journals give up or relax the control of academic quality by increasing the number of papers, artificially improving the influence factors forging peer review, and publishing inferior papers, thus causing harm to the scientific community. This phenomenon should be prevented in the development process of open publishing journals in China. Open publishing is not disorderly publishing, nor is it publishing without standards. In order to maintain the image and prestige of "gatekeeper" in the scientific community, academic journals should not only adapt to the requirements of digital development, but also take the social responsibility of journals, adhere to publishing ethics, and provide a reliable platform for publishing academic papers for the scientific community.

3.3.2.2 Digital Publishing Technology is the Basic Condition for Open Publishing

Open publishing is a process of helping the author's manuscript to be recognized by the academic community, but also a process of integrating digital technology and reshaping the journal publishing process with an Internet mindset. At present, the editorial department of most journals has the basic characteristics of digital publishing, such as manuscript management, journal paper website and multi-media integration. However, due to the small scale of journal publishers, it is difficult to carry out digital technology research and development independently, most of which rely on small technology companies so the publishing technology update and iteration is slow and cannot meet the needs of digital publishing.

The cluster project established by the "China Science and Technology Journal Excellence Action Plan" and the institutions funded by the International Journal Publishing Service Project, such as Science Press, Peking University Founder, Chinese Medical Association and Tsinghua University Press, have made breakthroughs in both cluster development and publishing technology. The SciEngine platform of Science Press shows the integrated functions of adopting international standards, embedding scientific research process and extending full-text reading services in the aspects of journal review, text structure, paper release and information association services. The paper publishing services of Peking University Founder set up a complete work process in manuscript management, text structure, and accurate recommendation service. It provides a new path for the

development of digital publishing of science and technology journals in China; it helps to build a publishing cooperation mode of small core and large network, with subject editing as the core and network technology as the support; it stabilizes the service quality of digital publishing technology, and improves the technical level of data publishing.

3.3.2.3 International Competitiveness is a Prerequisite for Open Publishing

With the continuous expansion of the scale of open publishing, journal publishing has changed from a limited carrier volume to an "unlimited" carrying space for papers, and the competition for authors, readers and peer reviewers will be more intense.

The digital environment brings readers unlimited space for information discovery, and the open publishing platform provides authors with diversified choice space. With the development of technology, academic communication has broken through the barriers of space and time, and language may not be a barrier to publication in the future. Only the quality and service ability of journals can attract authors, readers and peer reviewers, and make them willing to pay for their research results, reading time and identification and review energy. The current situation is that various performance evaluation indicators direct the flow of manuscript sources. In the future, the popularity gathered by the open publishing platform may attract the flow of manuscript sources, so Chinese science and technology journals will face international competition. Based on this cognition, the open publishing of science and technology journals in China should actively explore the effective operation mechanism, and constantly open up the space of academic exchange, so as to cope with the changes brought about by large-scale open publishing.

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Chapter 4

Expert Views: China's Scholarly Publishing and Communication Platform in the Digital Economy Era[1]

Editorial Note

With the rapid development of information technologies such as big data and artificial intelligence and their profound application in the publishing sector, the digital economy has become increasingly embedded in the scholarly communication ecosystem. This has led to the formation of an industry chain that links authors with publishers, content with technology, products with channels, and resource sharing with paid services. Traditional publishing models and dissemination methods no longer meet the demands for immediate, accurate, and diverse knowledge acquisition. The question of how STM publishing organizations in China can innovate their operating models and strengthen the competitiveness of journals in the digital age has become a key issue for STM journal publishers and administrative departments.

In order to reflect the opinions and perspectives of experts, researchers and publishing professionals on the "STM Publishing and Communication Platform in the Digital Economy Era", this chapter summarizes reports or keynote speeches from conferences organized by the China Association for Science and Technology in August 2022, such as the "STM Publishing in the Digital Economy Era" forum and the 17th Forum on the Development of China's STM Journals with the theme "New Stage, New Structure, New Mission – China's STM Journals Help Build China into a Great Power in Science and Technology". Relevant experts and researchers were specially invited to jointly discuss the development of China's STM journals in the context of the digital economy. These invited experts delved into the management concepts, development directions, and strategic measures for STM publishing in the digital age. They examined both domestic and international advances and trends in digital resources and academic exchange platforms, explored the development path of China's STM publishing integration and high-end academic exchange platform in the era of the digital economy, and proposed advice and

[1]Edited by Shengli Ren, Lingshu Qian and Jingjing Liu.

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suggestions for the development of China's STM publishing and communication platforms in the digital age.

Management Concepts and Development Directions of STM Publishing in the Digital Economy Era

The integration of digital technologies, such as big data, artificial intelligence, cloud computing, the Internet of Things, and blockchain technology into the real economy is deepening by the day. They are integrated into every sector and are continuously driving changes in production methods and lifestyles. Given the global trend of digital economy development, China's STM journals, which serve as important pillars for China's technological competitiveness and cultural soft power, must also seize these opportunities. China's STM journals must prioritize the development of digital publishing, dissemination, and service capacity building. By doing so, China's STM journals can leap forward in this transformation, better serve science, technology, and innovation in the era of openness, and contribute to the cause of building China into a great power in science, technology, and culture.

Based on the characteristics and trends of the digital economy, experts and scholars believe that the transformation of China's STM publishing should be understood and grasped in a broader context, with the accelerated construction of an intelligent academic ecosystem to adapt to the development of STM publishing in the new era. Academician Wei Yang said that with the development of scientific research and communication, open access as a trend of STM publishing has become an irreversible change. He suggested four ways to promote open science policies or measures for China's STM journals: (1) build a world-class academic data operation and service platform in China; (2) form composite entities to purchase open scientific data; (3) implement a basic price plus subsidy funding strategy; (4) promote open access group purchasing for top Chinese journals. Shulin Wu believes that China's STM publishing is experiencing unprecedented growth opportunities. He suggested that Chinese STM journals should consider expanding in six aspects: digitalization, open access, platform-based development, solution-oriented products, centralization, and internationalization, to raise the publishing level of STM journals and serve the national technological innovation strategy. Based on his analysis of the new characteristics and changes in STM publishing in the digital economy era, and in conjunction with the practices of the Light Academic Publishing Center, Jianlin Cao proposed development measures for STM publishing in five areas: building digital publishing platforms, dissemination and service capacity building, open science publishing operations, data openness and sharing, and recruiting and training digital publishing talents. Ke Gong pointed out that scientific development has set higher requirements for the speed, depth, scope, and accuracy of scientific services, and we should understand and embrace the transformation of scientific publishing in the context of the global progress in open science and China's new era of technological innovation, and promote the transformation of scientific publishing in the context of deepening the reform of the science and technology system. Yuguo Zhang briefly analyzed that the reason why China has become the most successful economy in the world is that the combination of "effective markets" and "proactive government" complements each other. He pointed out that as long as China's academic publishing strives for the original intention of "serving the researchers", and as long as it actively promotes the construction of "effective markets" on the basis of

"proactive government" and develops the industry with more market-oriented ideas, it will be able to cultivate globally competitive Chinese publishing enterprises.

Adapting Academic Publishing to the Development Initiatives and Effectiveness of the Digital Economy Environment

The booming digital publishing landscape marks an "epochal transformation" in the publishing industry. To meet the demands of scholarly communication and dissemination in the digital age, academic journals are moving from print to full digital editions: research papers are evolving from periodic publications to article-by-article publications, and the concept of the first publication of a paper is shifting from print appearance to online premieres. The focus of literature services is shifting from raw text delivery to knowledge services, and the commercial model of journal operations is gradually evolving from traditional subscriptions to open access. For STM journals, publishing methods have shifted from print to digital and online media, with early signs of an integrated publishing approach. The rise of digital publishing and online distribution has greatly expanded the reach of journals, providing a historic opportunity for their growth.

Experts and scholars, integrating the practices of media convergence, knowledge services, and digital platform construction, engaged in an in-depth dialog and discussion on how China's STM journals can develop with high quality in the digital economy era. Academician Yongfei Zheng emphasized that China is experiencing a rapid increase in research output due to the improvement of the overall national strength, China's STM journals should proactively adapt to the national requirements. They should promote multi-party synergy and joint promotion, with integration and innovation as a breakthrough, through the improvement of management capacity, healthy competition, knowledge service platform construction, talent team building and other initiatives to actively expand the business. Combined with the construction and development of the whole process of digital publishing and knowledge service platform (SciEngine) of Science Press, General Manager Bin Peng put forward suggestions for the high-quality development of China's scientific and technological journals in six aspects, such as standardizing the system and standards, promoting the development of clustering, realizing the technological empowerment, accelerating the merger and reorganization, building the first-class journals, and building the service team. Reviewing the 180 year development history of Springer Nature, General Manager Yanchun Wang elaborated on how academic publishing can seize the opportunity to build a diversified ecosystem of academic services to help researchers and scientific research institutions to improve their efficiency, evaluate scientific research results and widely disseminate scientific discoveries in terms of openness, intelligence and sustainability. By analyzing the effectiveness of the digital media operation of Metal Working Journal Press, President Yanwen Li believes that while digital technology poses a great challenge to the traditional publishing model of STM journals, it also brings new opportunities for the development of scientific and technical journals, and it is of great significance to explore how to maximize the value of scientific and technical papers using digital technology. Based on several digital publications such as *Engineering*, the journal of the Chinese Academy of Engineering, Ms. Ding Ning believes that digital publishing is a strategic opportunity for building world-class journals, knowledge service is the inherent demand of digital publishing for science and technology journals, and the construction of a high-end communication platform is the inevitable way for the development of STM journals.

Advice and Suggestions for the Development of China's Scholarly Communication Platform in the Era of Digital Economy

The 14th Five-Year Plan for the Development of the Digital Economy issued by the State Council in January 2022, analyzes the current status and situation of the digital economy, and puts forward specific content and corresponding initiatives in eight areas, including optimizing and upgrading digital infrastructure, fully utilizing the role of data, vigorously promoting the digital transformation of industries, accelerating the digital industrialization, continuously upgrading the level of digitalization of public services, improving the governance system for the digital economy, striving to strengthen the security system of the digital economy, and effectively expanding international cooperation in the digital economy. Undoubtedly, the plan provides important guidance for the publication of STM journals in China in the era of the digital economy.

For the development of the digital economy related to China's academic publishing and digital platform, experts and scholars have made a lot of useful suggestions in terms of upgrading and transforming of industrial chain structure, operation mechanism, and profitability. Yuanchun Zhou believes that data, as a key element of the digital economy, has shown a trend of explosive growth and massive agglomeration since the beginning of the 21st century and has become an important force for achieving innovative development, and measures should be taken from aspects such as macroscopic institutional safeguards, building scientific data publishing platforms, and expanding of the enabling effect of scientific data publishing to further bring the role of data elements into play. By analyzing the new initiatives of global STM journals in the open science environment, Zhixiong Zhang suggests that China's STM journals should take the initiative to adapt to and develop a new type of academic communication in the areas of OA publishing model, preprint publication and open peer review, support the demand for scholarly services in all segments of open science and develop deep and fine-grained specialized knowledge products. Mingshen Zhang briefly analyzed the 14th Five-Year Plan for the Development of the Digital Economy and pointed out that the rapid development of digitalization has brought many disruptive changes to academic publishing. This is reflected not only in the complete digitalization of the entire industry and the emergence of a new generation of academic publishing service technologies but also in the shift of the academic publishing business model from subscription to open access. Open access platforms, in which interconnected data can be easily shared, accessed, used, and evaluated under certain rules, could become the main space, the main channel, and the main arbiter for academic dissemination and evaluation. Shuai Yan believes that digital products, digital management, and digital standards are the three key issues for the development of the digital economy of academic journals in China. With the rise of open science, digital products such as academic journals, research articles, and related data will become more and more abundant, and the management of China's journals, research articles, platforms, evaluations and other management in the era of digital economy requires innovative concepts and institutional arrangements, and there is still a lot of basic work related to the digitalization standards of academic journals to be completed. Xing Shao believes that for the integrated development of STM journal industry in the context of the digital economy, the integrated service platform is the prerequisite, which is the foundation of the integrated development of STM journal industry; the professional knowledge service is the core, which is the guarantee for the integrated development of STM journal industry to be self-sustaining,

self-circulating and self-developing; the perfect ecosystem is the ideal state, which is the ultimate goal for the formation of a new pattern of development of STM journals.

4.1 Operation Concept and Development Direction of Academic Publishing in the Digital Economy Era

4.1.1 Wei Yang: Reflections on China's Open Science Roadmap and Policy System[2]

As scientific research and communication continue to evolve, academic publishing has undergone a fundamental and irreversible shift towards open access. The overall development of open science has been placed on the agenda. For researchers, this shift towards open science offers the potential to improve both the reliability and accessibility of scientific data.

The open science movement was initially led by Europe, with active participation and support from developing countries. In terms of global scientific productivity and impact, China has become a world leader in disciplines such as chemistry, engineering, materials science, computer science, and agronomy over the past decade. In terms of the volume of international research publications, China has become a world leader in many academic fields and has the highest number of open-access scientific publications. This makes China a key player in the global dynamics of open science. China's active participation in this movement will play a significant role in the development of a global scientific community with a shared destiny.

4.1.1.1 Open Science in China Faces Two Major Challenges for Its Acceptance by the Academic Community

At present, the development of open science in China faces many challenges and opportunities. To begin with, there is a lack of participation from China in the open science movement, where the concept needs to be more proactively promoted. In addition, the acceptance of open science within the academic community in China faces two major challenges that need to be addressed: first, how to ensure that it is mutually beneficial to all stakeholders; and second, how to change the reputation of open access within the academic community.

For the first challenge, the most obvious problem is the imbalance in the rights and responsibilities of the various stakeholders in the transition to fully open-access content: readers, authors, publishers, libraries, and funders. This raises several questions: Are the new rights and responsibilities acquired by scholars in open science balanced? What are the responsibilities of readers who gain access without paying? It may be legally dubious for

[2]Wei Yang, an Academician of the Chinese Academy of Sciences, is also the former director of the National Natural Science Foundation of China.

authors without financial support to bear the Article Processing Charges (APC). In addition, publishers have moved to new business models (from subscription-based to APC-based) and new sales models (consortium purchasing); libraries may no longer have to pay subscription fees but also lose access to data; funders may become major payers for APCs, but why should the funding agencies bear the overpayment?

Regarding the second challenge, trends in international scholarly publishing suggest that OA has become a prominent publishing model with well-defined business and distribution structures. Currently, China leads the world in the number of articles published in OA journals. However, the average impact factor of OA journals in which Chinese scholars publish is low, and 75% of articles are published in lower-tier OA journals, including quite a few which are very close to the so-called "gray area".[3] While OA journals initially suffered from a poor reputation, there has been tremendous growth in recent years. Top-tier journals, such as those in the "Nature" series, are moving from hybrid models to transformative models, with nearly a hundred journals joining the process. Most of China's STM journals supported by the China STM Journal Excellence Action Plan, jointly implemented by seven organizations and ministries including the China Association for Science and Technology (CAST), have also adopted the OA publishing model. In addition, the introduction of the blacklist of predatory journals has also curbed the emergence and development of predatory journals.

4.1.1.2 Three Challenges in China's Implementation of Open Science

First, who would be the entity to push open science forward? Under the subscription model, the consortium organizer is guided by price negotiations led by the China Academic Library & Information System (CALIS) from 2000 to 2035. Individual libraries manage subscriptions, academic institutions handle payments, and thus have rights to use the purchased databases within designated IP groups. Under the OA model, authors comply with a standard price to pay the Article Processing Charge (APC), and the academic institutions no longer own cloud-based databases; thus, it is inappropriate for government departments to negotiate group purchases with database providers directly. Therefore, which entities should initiate consortium purchasing, and which entities should pay for the purchasing becomes an issue.

Second, how to mitigate the price gap gradually? China's rise from a developing country to a research superpower over 20 years has created a unique pricing dynamic. Under the subscription model, CALIS led the negotiation of the price framework, the database price is supposed to increase all the way from the starting price for developing countries in 2000 to 80% of the world average by 2035. The APCs for OA articles are set according to world average prices. Currently, the total publishing costs paid from China (subscription fees + APCs) occupy 6%–8% of the global total, while its share of SCI papers published in 2020 already reached 28.5% of the world total. Transitioning fully to the OA model could lead to a three to four-fold increase in publishing costs. With the

[3]The translator's note: the journals in the gray area, tend to make profits from publishing papers to meet the huge demand from Chinese authors. In order to maximize profits, these journals accept all the papers submitted without any screening and reviewing and charge a high amount of fees from all the submitting authors. This naturally leads to low quality and bad reputation of these journals.

above-mentioned, how to gradually mitigate the price gap? This is a problem that cannot be ignored.

Third, how to sustain the steady growth of China's STM journals? Assuming a global transition from subscription to OA is completed, and research funders and publishing platforms reach consortium purchase agreements, China's major academic institutions would get access to the scientific data on the corresponding publishing platforms and limited publishing rights, *i.e.*, free from APC within an agreed quota ("read and publish" agreements). Consequently, authors from these institutions would submit most of their manuscripts to these purchased "read and publish" platforms and these platforms will enjoy a good reputation and high impact and are open and free. While with China's over 5000 journals scattered to belong to 4000 legal entities, initiating consortium purchases becomes challenging, potentially resulting in losing significant high-quality submissions. The abrupt flip to the OA model might therefore lead to a plummet of China's STM journals. Stabilizing the development of China's STM journals has become an inescapable issue.

4.1.1.3 Four Development Paths for the Implementation of Open Science in China's STM Journals

4.1.1.3.1 Establishing a World-Class Academic Data Operations and Service Platform in China

Such a platform should incorporate a dedicated information and analysis team, demonstrate platform operational capability (including stream computing, servers, and an applications team), maintain open scientific data comparable to that of competitors (including type, volume, and quality), demonstrate diverse autonomous combinatorial service capabilities, and maintain credibility within the scientific community.

4.1.1.3.2 Forming Composite Entities to Acquire Open Scientific Data

The library consortium of various academic institutions shall continue to act as the formal entity. The pricing framework under the subscription agreement shall be set as the starting price for consortium purchases. The access rights should continue to cover the IP ranges of academic institutions. The designated IP address range of academic institutions shall be used to identify users who are exempt from APC charges. For example, China National Publications Import and Export (Group) Co., Ltd. (CNPIEC), which has the right to import and export scientific data, or the National Natural Science Foundation of China (NSFC), which holds publication funding, can act as the leading entity.

4.1.1.3.3 Adopting the Price Strategy of Base Price Plus Subsidy

All institutions involved in consortium purchasing contribute a base price, not less than that of the original data subscription model, with dedicated national funds for scientific data construction acting as strategic forces for open science. These funds, supplemented by national fiscal policies and social support, can bridge the price difference in consortium purchases of scientific data, with part of the profits from the operation of the "Open Science and Service Platform" being used to support the fund in return.

4.1.1.3.4 Encouraging OA Consortium Purchasing of China's High-Quality Journals
Initiatives such as the China Science and Technology Journal Excellence Action Plan have provided some leadership to the Chinese journal community. I hereby suggest forming an evaluation mechanism led by CAST for more than 5000 of China's STM journals. Based on this evaluation, a list of journals qualified for the national open science database could be compiled. Following the consortium purchasing model for data on international open science publishing platforms, the above-mentioned funds could purchase the selected journals. This whole process may be carried out with dynamic adjustments made as needed.

4.1.2 Shulin Wu: Enhancing the Publishing Standards of Academic Journals to Serve the Chinese Sci-Tech Innovation Strategy[4]

China's scholarly publishing industry is currently experiencing unprecedented development opportunities. This is manifested in several aspects: the strong emphasis of the Party and the state has pointed out the direction for building a strong publishing country; the rapid socio-economic development and the huge economic scale provide a solid foundation; the comprehensive prosperity in education ensures an abundant supply of competent talents; the steady growth in R&D investment guarantees a continuously growing source of content; the world's largest number of published papers has laid a realistic foundation; while a sound publishing system and accumulated publishing experience provides an important guarantee. Overall, China's scientific research strength and the number of paper outputs are still in the stage of rapid improvement, while both the quantity and quality of STM journals still have a lot of room for development.

Scholarly publishing is an integral part of scientific research and the core of the cultural industry. We should study and summarize publishing experience at home and abroad and then accurately grasp the characteristics of scholarly publishing. Our rise as a publishing superpower is largely due to our ability to draw on past and foreign achievements, utilize various resources, continuously promote innovations of knowledge, theory and methodology, always remember our roots, learn from global practices, and actively face the future.

Historically, the social role of scholarly publishing has evolved to advance with time. Nowadays academic publishing is increasingly becoming a significant front and platform for a country to gain the right of speech and respect on the global stage. In the context of adhering to the spirit of science and following strict scientific norms, the quality of academic publishing and market operation go hand in hand. In fact, according to the WTO classification, the scholarly publishing industry, including academic journals, is considered part of the service sector. Academic journals have been consciously integrated into scientific research and socio-economic development and have established their status through their services. In particular, the changes in the global publishing industry over the past 30 years are worthy of our attention and study. Propelled by information technologies such as AI, big data, blockchain, and especially the metaverse, international publishers have gradually found new models to lead development under these circumstances. With the

[4]Shulin Wu, Chairman of the Publishers Association of China.

emergence of numerous social media platforms, international publishers are driven to improve their service level and seek new knowledge service solutions.

In order to promote the prosperity of scholarly publishing in China, taking into account the development and future trends of journals at home and abroad, I suggest that the development of China's journals can be further expanded in the following six areas.

(1) Digitization. Digitization is the foundation of the future of publishing. Without digital content, it's impossible to apply technologies such as AI, big data, and blockchain in publishing. Taking RELX Group as an example, the share of its digital revenue has increased from 22% in 2000 to 86% in 2021. In general, the digitization of academic journals in China is still in its early stages and deserves our attention.

(2) Openness. The Open Access (OA) publishing model has gained global recognition, with some high-quality international journals flipping to an OA model. The STM Trends 2026 Forecast by the International Association of Scientific, Technical & Medical Publishers foresees a proliferation in platforms offering Open Access, accelerating knowledge dissemination and discovery. Over the past decade, China has become the world's second-largest producer of OA articles, steadily increasing its lead over second-tier countries. However, a significant proportion of China's OA papers are published in foreign journals and platforms, indicating an inadequacy in the quantity and standardization of China's OA journals. Therefore, it is urgent to take measures to increase the quantity of China's OA journals and improve the quality of these journals.

(3) Platform-based development. Knowledge production is an important tool for maximizing social progress and well-being with few inputs. It is essential for the publishing industry to work with the technology and business sectors to build its own platforms to survive and thrive. Particularly in an open science environment, it is crucial for us to have a significant presence on global platforms in order to leap-frog our competitors. We should make efforts to build more platforms like SciEngine launched by China Science Publishing & Media Ltd. (CSPM), with the goal of building high-end platforms for China's scientific research papers and technology information exchange.

(4) Solution-oriented products. Professional publishing has evolved from paper-based publishing to online databases, and now to digital decision-making solutions. Solution-oriented products for the publishing industry ensure data quality and their platform impact. Moreover, these tools are now gradually being integrated into the entire scientific research process.

(5) Concentration. Globally, from 1665 to the present, journals in both the social and natural sciences gradually became part of large publishing groups, with half of the world's scholarly articles being published by the top 10 publishers. As far as China is concerned, we should follow the national policy direction and build influential STM journal clusters through various paths such as integrating journals and launching sub-journals of well-known journals.

(6) Internationalization. High-level academic journals have been internationalized from the beginning. No single country can support its own academic publishing ecosystem on its own. As Henry Oldenburg wrote in his address to the first issue of the "*Philosophical Transactions*" in 1665, the papers published in this journal belonged not only to the United Kingdom, but also to Europe and all the world, and were relevant from time to

time, both in the present and the future. The development of China's STM journals also requires an international mindset and vision. KeAi, the joint venture established by CSPM and Elsevier, has achieved remarkable success in promoting China's STM journals to march out and participate in international competitions. Such a collaboration model should be explored and learned from other Chinese publishers.

In conclusion, in order to improve the level of academic journals, it is of paramount importance to integrate publishing work into serving China's sci-tech innovation, social development and people's well-being to find the fundamental basis. In the process of the great rejuvenation of the Chinese nation, to build a publishing system that is both relatively complete and participates in international markets, and to serve China to become the center of the world's economy, science and technology, and culture, Chinese publishers should have such aspirations and pursuits.

4.1.3 Jianlin Cao: Transformation of STM Journals into STM Media in the Digital Economy Era[5]

With the rapid development of advanced technologies such as big data, artificial intelligence, cloud computing, Internet of Things (IoT), and blockchain, the global digital economy, with its characteristics of standardization, specialization, platform-based, and knowledge sharing, has been fully and deeply integrated into the real economy through digital technologies, reshaping production methods and lifestyles in all fields. According to the "White Paper on the Development of China's Digital Economy (2022)", China's digital economy will grow at an average annual rate of 45.9% since 2021, significantly outpacing the average GDP growth rate. With the development of China's sci-tech endeavors, China's sci-tech strength is evolving from accumulating quantity to significantly improving quality. Accordingly, as an important support and platform for China's sci-tech competitiveness and the soft power of Chinese culture, STM journals shoulder the honorable mission of building China into a world power in science and technology and also in culture. Given the global digital economic trends and China's advantages, investing in promoting the construction of digital publishing, dissemination and service capacity of China's STM journals, realizing the transformation of STM journals into STM media, and building an intelligent academic ecosystem are the development trends of academic publishing in the era of digital economy.

4.1.3.1 New Characteristics and Changes in Academic Publishing in the Digital Economy Era

In the open science environment, digital publishing shows some new characteristics with evolved dissemination modes. The emergence of models or platforms such as OA publishing, pre-print, and blockchain have promoted open access, research integrity, and data sharing and interaction. The communication model has transformed from one-way to

[5]Jianlin Cao, Editor-in-Chief of the journal "*Light: Science & Applications*", former Vice-Minister of the Ministry of Science and Technology of the People's Republic of China.

two-way, allowing people to communicate and interact in both directions through digital publishing platforms.

The growing demand for rich media and cross-platform digital content has paved the way for enhanced publishing, a new model of scholarly publishing in the digital era. STM journals are adopting this model to increase the impact of scholarly dissemination and promote scholarly exchange. Through the comprehensive use of rich media and new technologies, rich media audiovisual content has become an important form of communication in the era of digital economy. Traditional graphics and text have realized a deep integration with audiovisual content such as audio, short videos, and online live streaming. In the context of the metaverse, AR/VR, 3D, and holographic display technologies will further promote the upgrading and iteration of enhanced publishing, providing audiences with a richer visual experience.

With the accelerated pace of digital publishing empowered by technological upgrading, the access channels to sci-tech information have become diversified. Under the impact of the overwhelming volume of information on the Internet, people have put forward higher requirements for the accuracy and specialization of knowledge services. Providing professional and accurate knowledge services to meet the personalized needs of audiences has become an important embodiment of the core competitiveness of scholarly publishing in the era of the digital economy.

4.1.3.2 Implementation Strategies for Transitioning STM Journals to STM Media in the Digital Economy Era

STM media is a new type and more complete media communication system developed based on traditional media. In the era of digital economy, scholarly media is characterized by five basic features: (1) Diversity of content and forms of communication; (2) Wide range of information search; (3) Accuracy of science and knowledge communicated; (4) Advanced technological tools and platforms; (5) Pleasant user experience. These characteristics reflect the unique strengths of STM media. Based on these characteristics and advantages, STM media provides a publishing service platform for STM journals using advanced technologies, a specialized knowledge service platform for scientific researchers, and an industry-education-research integration platform for the application of research results. In the era of the digital economy, the transformation of STM journals into STM media is an inevitable trend. The realization of this transformation requires the use of big data, artificial intelligence and other advanced technologies to help content dissemination and discovery, to build a journal digital publishing and dissemination platform, a cluster operation platform to operate journal aggregation, and a knowledge service platform for vertical segments, and thus construct an intelligent academic ecosphere.

To adapt to this transformation trend, the Light Publishing Group of Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP) of CAS has been rooted in China with a global perspective in recent years. It aims to establish Light sci-tech media with Chinese characteristics and international influence and to build an academic ecosystem around the Light brand. Leveraging new technologies such as AI and big data, the Light Publishing Group has collaborated with Beijing Founder Electronics Co., Ltd. to build a comprehensive STM media platform that integrates resource management, journal publishing, international dissemination, and knowledge services. This platform gathers the

leading journal *Light: Science & Applications*, the high starting point new journals *eLight* and *Light: Advanced Manufacturing*, and high-quality journals in Chinese-language, such as *Optics and Precision Engineering* (OPE), *Chinese Optics* (CO), *Chinese Journal of Luminescence* (CJL), *Chinese Journal of Liquid Crystals and Displays* (CJLCD). It focuses on covering the high-level innovations from Nobel Prize laureates, academicians and experts in the field of optics and its cross-cutting frontiers. The platform can be accessed by authors, readers, and experts from more than 30 countries and regions, promoting the integrated development of global open science. This platform encompasses various brand IPs, including the Light Conference, Light Rising Star, Light Conference Week campaigns, the live broadcast platform "Light Online", Light Future Star Selection Awards, Light Doctoral Academic League, China's Top 10 Influential Optical Events (Light10), Light People, Light 10th, Light Popular Science Workshop, Seed of Light Scholarship Program, and Academicians' Interviews. Presented in a rich media format combining information, videos, papers, data, charts, and scholars, offers technology consultation aggregation, research activity tracking, and academic achievement profiling for scientists and emerging scientists through structuring, categorizing, and correlating contents. For platform users, it provides cross-modal association and recommendation services based on application scenarios. Leveraging Light's media strategy of "aggregation, association, and recommendation", it achieves interconnectedness, open sharing, and precise services between high-quality journal resources and brand academic communication resources. It has established the Light brand academic ecosystem, centered on the "scientific community" and supported by an advanced tech-based media platform.

4.1.3.3 Recommendations for the Development of Academic Publishing in the Digital Economy Era

Considering the new features of academic publishing in the digital economy era and the trend of transitioning STM journals to STM media, I have the following suggestions for the development of academic publishing in this era.

Regarding the construction of digital publishing platforms, the intensive management and group construction of journals should be strengthened. Optimize resource allocation and promote media integration. Leverage new technologies such as artificial intelligence, big data, and blockchain technology to build an open STM publishing platform that encompasses resource management, journal publishing, international communication, and knowledge services. This will facilitate openness, sharing, exchange, and collaboration in digital publishing.

In terms of dissemination and service capacity building, it is time to rethink publishing formats and introduce new services. STM journals should meet the personalized needs of the audience, shorten the publishing cycle, carry out reproduction and dissemination in various forms and through various channels, such as on-demand publishing, semantic publishing, and enhanced publishing, etc., provide personalized and precise services for users, and enhance the service capability and brand influence. We should leverage modern technology to deeply integrate into STM journal publishing, and promote the dissemination of STM journals and the effectiveness of knowledge sharing.

In terms of publishing operations in the context of open science, the primary profit model for academic publishers or STM journals will flip from the traditional subscription

model to the OA (Open Access) model. Relying solely on copyrighted content to make profits can no longer adapt to the current open science development trend. Therefore, new modes of academic publishing services must be explored. For instance, Elsevier, oriented by market demands, has expanded its business into information and data analysis services through acquisitions and collaborations. It has established knowledge bases in many specialized fields and evolved from a publisher to a provider of information and data analytics and solutions. Catering to the actual needs of researchers, offering digital academic services empowered by new technologies throughout the whole research process will become a crucial channel for academic publishing operations. This includes services for early-stage research knowledge, paper publishing, and the dissemination of research results.

Regarding data openness and sharing, China has continuously put more emphasis on the management and open sharing of scientific data. China has successively issued the "Measures for the Administration of National Scientific and Technological Resource Sharing Service Platform" and the "Measures for Scientific Data Management" and other regulations. As a result, 20 national scientific data centers have been established. The next step is to innovate new publishing models of scientific data, accelerate the construction of digital infrastructure, establish reasonable open data policies and complete data management systems, reinforce intellectual property protection, and strengthen the foundation for research integrity. This will lead to efficient convergence, open sharing, multidisciplinary cross-integration and analysis and innovative application of scientific data.

In the realm of introduction and cultivation of digital publishing talents, it is essential to emphasize the combination of talent recruitment and independent training. Publishers need to discover and nurture multi-faceted digital publishing professionals, design digital publishing talent selection and training programs, establish a scientific and logical performance appraisal system and incentive mechanism, increase the initiative and creativity of the talent team, and provide talent foundation and guarantees for constructing a robust ecosystem of academic publishing in the digital economy era.

Through the above measures, we aim to further accelerate the transformation of STM journals into STM media in the era of the digital economy, and build an open, intelligent academic ecosystem.

4.1.4 Ke Gong: Open Science, Technological Innovation, Deepening Reforms, and the Transformation of Scientific Publishing[6]

Scientific publishing is an essential part of the scientific endeavor. It has become an intrinsic service industry due to the continuous emergence of needs for communication and dissemination within the development of science. As we enter an open era, the development of science places higher demands on the speed, depth, breadth, and precision of scientific services. How scientific publishing can achieve leapfrog development during its transformation, and better serve technological innovation in this open era, should be understood and grasped within a broader context.

[6]Ke Gong, President of the World Federation of Engineering Organizations (WFEO) and former President of Nankai University.

4.1.4.1 Understanding and Grasping the Transformation of Scientific Publishing in the Global Development Trend Toward Open Science

"Open Science originated from a movement several decades ago, aimed at changing scientific practices to adapt to the changes, challenges, opportunities, and risks of the digital age, thereby enhancing the social impact of science"[1]. Although this movement received varying degrees of support from various countries' governments, especially those of the European Union, it was not until November 2021 that the "*UNESCO Recommendation on Open Science*" passed by the 41st General Conference of UNESCO became the first international guideline document on open science. This elevated the grassroots movement of open science to an endeavor jointly promoted by various countries' governments worldwide.

The ancients believed that without properly understanding the current trends and blindly applying either strict or lenient policies, it would lead to grave consequences. Ever since the information revolution, from the digitization of information representation to the digitalization of the economy and society, the trend has been unstoppable like surging tides. Just as digital cameras became rapidly widespread and completely disrupted the traditional photography industry, open science will inevitably drive a revolutionary transformation in scientific publishing, which is a historical trend not subject to human will. As time changes, so must practices. Under the prevailing trend of open science, scientific publishing must adapt to the open science values of "collaboration and sharing". It must embrace practices that "encourage the use of open licensing, add materials to the public domain and make use, as appropriate, of flexibilities that exist in the intellectual property systems to amplify access to knowledge by everyone for the benefits of science and society and to promote opportunities for innovation and participation in the cocreation of knowledge". This requires a profound transformation of its own.

From a global perspective on the development of open science, the transformation of scientific publishing should be based on the "fundamental principles of academic freedom, research integrity, and scientific excellence". It should be guided by the values of "collaboration and sharing," aimed at "enhancing reproducibility, transparency, sharing, and collaboration". The goal should be to "improve the effectiveness and productivity of scientific systems by reducing duplication costs in collecting, creating, transferring and reusing data and scientific material, allowing more research from the same data, and increasing the social impact of science by multiplying opportunities for local, national, regional and global participation in the research process, and opportunities for wider circulation of scientific findings". In the new scientific paradigm, the role of scientific publishing is repositioned[1].

The transformation of scientific publishing must embody the core values of open science. According to the "*UNESCO Recommendation on Open Science*", these core values include (1) Quality and integrity: To achieve this, scientific publishing must aggregate multiple sources of knowledge, make research methods and outputs widely available, organize rigorous reviews and scrutiny, implement transparent evaluation processes, and support high-quality research. (2) Collective benefit: For this, scientific publishing must endeavor to make scientific knowledge openly available, benefiting the entire scientific community and the general public. (3) Equity and fairness: To this end, scientific publishing should strive to ensure that scientific input and output are shared fairly and reciprocally, allowing equal access to scientific knowledge for both producers and

consumers. (4) Diversity and inclusiveness: In line with this, scientific publishing should aim to provide appropriate support for diverse research communities and scholars, as well as the wider public beyond the traditional scientific community[1].

4.1.4.2 Understanding and Grasping the Transformation of Scientific Publishing in the Grand Scheme of Technological Innovation in China's New Era

Historically, China missed out on several opportunities during past technological revolutions, resulting in a late start for both its scientific endeavors and its scientific publishing industry. However, with reform and opening up, China seized the historical opportunity of the information revolution. Consequently, China's sci-tech sector experienced rapid development, swiftly elevating the country to the status of a major global player in both technological innovation and scientific publishing. Nevertheless, the 20th National Congress of the Communist Party of China pointed out that we must not lose sight that our country's "capacity for scientific and technological innovation is not yet strong enough"[2]. In response, the 20th National Congress of the Communist Party of China laid out significant plans for "improving systems for scientific and technological innovation" and "accelerating the implementation of the innovation-driven development strategy". The transformation of China's scientific publishing must uphold this innovation-driven development strategy. It should set the goal to "boost the overall performance of China's innovation system" and to "create an open and globally competitive innovation ecosystem"[2]. To position the transformation with a focus on providing high-quality, in-depth services for scientific and technological innovation, as well as efficient services for the popularization of science.

Providing high-quality, in-depth services for technological innovation entails serving the entire innovation process and offering targeted services to the main bodies of innovation (researchers and research institutions). It also means continuously improving services to meet the ever-changing new demands. Taking literature retrieval as an example, the core issue today is no longer the lack of data or information, but rather the ability to quickly pinpoint truly valuable information in the midst of "data flooding" and "information explosion" and to discover knowledge and establish connections from the vast amounts of data and information. This requires the shift from retrieval services to knowledge services, which can even provide personalized in-depth knowledge services through the same keywords to different users. Such services should encompass the ability to rigorously scrutinize and solve complex and interconnected problems. They should strive to enhance the transparency, credibility, and validity of scientific information. It should involve sensitivity to conflicts of interest, vigilance against potential social and ecological consequences, adherence to research integrity, and compliance with relevant ethical standards. It also entails a strong sense of responsibility for the sustainable development of both humanity and the planet Earth.

4.1.4.3 Planning and Promoting the Transformation of Scientific Publishing Within the Context of Deepening Structural Scientific and Technological Reform

To provide high-quality, in-depth services for scientific and technological innovation, scientific publishing must harness the power of reform. This reform should be integrated into the overall framework of national structural scientific and technological reform. It requires a comprehensive understanding of the public service and market-oriented service

functions in the transformation of scientific publishing. It also necessitates the development of sustainable financing and investment policies and strategies, as well as the cultivation of new market structures and mechanisms.

Reforms must be deepened not only within scientific publishing organizations but throughout the entire scientific publishing system. For instance, it is necessary to break down barriers between different scientific publishing organizations. At the current stage, there are still many obstacles such as literature formatting, document downloading and reference queries. With an orientation towards open science, scientific publishers need to effectively establish agreements that clarify data sharing, data formats, metadata formats, terminologies, and share the infrastructure for open science. Additionally, there should be efforts to open up the channels for collaborations between traditional scientific publishing and various emerging technology service platforms, integrating multiple media, and actively developing new tools like knowledge graphs, data visualization, and augmented reality, etc. Particularly, breaking down the so-called "system" barriers (a reference to the old planned economy system, not the system of socialism with Chinese characteristics), diversifying the integration, development, and allocation of scientific and technological service resources. This involves collectively building and sharing a new type of scientific and technological service infrastructure based on the Internet, big data, artificial intelligence, and advanced computing.

4.1.5 Yuguo Zhang: Promoting the Combination of "Effective Markets" and "Proactive Government" in STM Publishing[7]

Over the past forty years, China's development has achieved globally recognized accomplishments, making it the world's most successful economy. The "secret weapon" behind China's success has been summarized by some as two aspects: first, the "effective market," and second, the "proactive government". Both complement each other and neither can be neglected. The Communique of the fifth plenary session of the 19th CPC Central Committee explicitly states: "to fully leverage the decisive role of the market in resource allocation, make better use of the role of the government and to promote the better combination of an effective market with a proactive government". This issue has also attracted the attention of economists. The Institute for Chinese Economic Practice and Thinking, Tsinghua University (ACCEPT) and the Society for the Analysis of Government and Economics (SAGE) have jointly hosted four Annual Conferences on Government and Economics and launched "*The Journal of Government and Economics*". Elsevier under the RELX umbrella has the honor to publish this journal.

Under such a major premise, when we discuss the development of academic publishing today, there are two questions we need to reflect upon: First, whether academic publishing is a component of China's economy? Second, whether academic publishing should also advocate for the combination of effective markets and a proactive government?

[7]Yuguo Zhang, Senior Vice President of RELX Group China.

The answer to the first question is quite evident. It is well known that the publishing industry (including academic publishing) is a vital component of the cultural industry, and the cultural industry plays a significant role in the national economy. According to data released by the National Bureau of Statistics in 2020, the added value of the national cultural and related industries was 4494.5 billion yuan, a growth of 1.3% from the previous year, accounting for 4.43% of GDP. If academic publishing is viewed as an "industry," then it is inevitably a component of China's economy.

As for the second question – whether academic publishing should also advocate for the combination of effective markets and a proactive government? I believe the answer is also affirmative. In fact, many detours have been taken because this combination was not achieved effectively. This is also the major reason why China's academic publishing is not strong enough on the international stage.

In the field of academic publishing, the "proactive government" has put in place many measures and achieved much, but the promotion of an "effective market" remains far from sufficient. Taking STM journal publishing as an example, our most esteemed leaders, highest-ranking meetings, and most important documents have all emphasized supporting STM journal publishing, which is rarely seen in the world. At the national level, the financial support dedicated to academic publishing has also been very substantial, exceeding several billion yuan over the past five years. Conversely, RELX Group is headquartered in the United Kingdom, its subsidiary Elsevier is based in the Netherlands, and "*Cell*", one of the leading academic journals is based in the United States. These three countries have never had national-level plans to support the development of STM journals, or government financial support. Nevertheless, RELX Group remains the world's largest publisher in terms of scale (ranked the first globally for three years consecutively), and Elsevier stands as a leading STM publisher, housing top-tier STM journals such as "*The Lancet*" and "*Cell*".

Based on China's actual situation, it is necessary for the state to provide input and support at the early stage of academic publishing (especially STM journal publishing). But beyond this stage, it is important to explore how to develop "staying power" and sustainability. This means actively promoting an "effective market" on the basis of a "proactive government". In this regard, both government regulatory departments and publishing organizations need to play their roles and enhance the awareness of urgency. Taking the development of STM journals as an example, after I returned to China in 2007, I participated in numerous seminars representing RELX Group to share experiences with the theme of "how to launch top-level Chinese STM journals". However, 15 years have passed, and it seems like we are circling the same wagons without making progress, while international publishers have already shifted their strategic priorities far beyond this stage.

How can academic publishing, especially STM journal publishing, drive the effective market? First of all, there must be a clear understanding of the market. Based on my observation, there are three distinct characteristics of the global academic publishing market.

4.1.5.1 English Language Dominating with Global Competition

The global academic publishing market is a unified, competitive arena. According to the data from the international consulting firm Outsell and the STM Association, the global STM book and journal publishing market (narrowly defined) is valued at $14.6 billion,

and the global STM information services market (broadly defined) is valued at $176.1 billion. In such a huge international market, how much share does China occupy? How many of China's publishers are there among the top five or ten academic publishers? In this market, scientists worldwide publish, share, and read their research results in the English language, rather than in separate domestic or regional markets.

4.1.5.2 Brand First, Service Paramount

In this field, roles must not be reversed: scientists are always playing the leading role, and academic publishers are playing a supporting role. A strong brand and quality service are crucial, as scientists prefer to publish their results in journals that offer these. The publishing industry is, fundamentally, a service industry; it all comes down to service quality and brand strength. If publishers were to use alternative methods or means to require or even force scientists to publish in their journals, would this approach be sustainable? Could these publishers or journals remain competitive in the international marketplace?

4.1.5.3 Digitalization and the Use of Advanced Technologies Have Become a Major Trend

The future competition in international academic publishing is no longer just about launching one or two top-tier journals; it's about whether effective market players (publishers) can make good use of digitalization and advanced technologies such as AI to provide better services to the research community. The future competitive edge lies in "data + technology + service". Take RELX Group, the company I work for, as an example: in less than a decade, it has undergone a rapid digital transformation, with only 7% of its revenue now coming from print publications. The company has ventured beyond traditional publishing into the realm of big data by proactively utilizing technologies such as big data and AI. For example, in international markets, the company can collect data from over 10 000 data sources and has now accumulated vast amounts of data. The group also owns one of the world's most advanced big data processing systems, the HPCC (High-Performance Computing Cluster) system, which forms its core competency in big data.

I also have the following suggestions for the development of scholarly publishing in the future:

(1) Emancipating the mind and finding the right position
In the field of academic publishing, we should keep in mind that scientists and researchers are the protagonists and we in the publishing industry merely play a supporting role. We must not reverse this role and make demands on scientists. We should have the courage to compete with our global peers in a race to provide better publishing services to scientists all around the world.

(2) Experimenting institutional and mechanism innovations
The core of institutional and mechanism innovations is to nurture a batch of market entities (publishing enterprises) with international competitiveness. The main players in the market competition are publishing houses instead of government departments. Only with robust publishing enterprises can China compete internationally. Of course, reforming institutional mechanisms is challenging. It might be considered to first

implement pilot projects before wider application. For example, KeAi under Science Press is an excellent pilot project.

(3) Enhancing capital operations and accelerating talent cultivation
Under the current situation, capital operations may be a shortcut. If the investment for organic development is large, and it takes a long time to develop, publishers can consider mergers and acquisitions. Take RELX Group as an example: as a multinational corporation, it carries out dozens to even hundreds of acquisitions globally every year. International M&A requires experience and talent, and RELX Group is willing to share our expertise with our Chinese partners. Ultimately, what we do, all boils down to talents. We should look further ahead, and see the employees currently working for foreign publishing companies as potential talent resources that China's academic publishing can rely on in the future.

I firmly believe that in the field of academic publishing, as long as we stay true to the original intent of "serving scientists and researchers well" and actively promote the development of an "efficient market" based on the foundation of a "proactive government," and continue to develop this industry with a market-oriented mindset, we can certainly cultivate the "RELX Group of China" and the "Chinese version of Elsevier" — globally competitive Chinese publishing enterprises.

4.2 Development Measures and Achievements of the Academic Publishing Industry Following Advancements in the Digital Economy Era

4.2.1 Yongfei Zheng: Integration and Innovation-Catalyzing High-Quality Development of STM Journals[8]

On August 9, 2022, the latest report by the National Institute of Science and Technology Policy (NISTEP) of Japan revealed that China has now overtaken the United States by a narrow margin in the number of top 1% leading papers after China surpassed the US in the total number of SCI-indexed papers and the number of "top 10% most-cited papers", claiming the global lead. This signifies that China has become the "triple crown" winner in all three key representative indicators of research papers in the natural science field.

In light of the rapid growth in both the quantity and quality of scientific papers in China, it is important for us to reflect: what are the significant original innovations and contributions made by Chinese scientists in shaping the new academic directions? It has been 45 years since Madame Tu Youyou published her work which won her the Nobel Prize; In which research direction and when will the research results from China appear to win the next Nobel Prize for Chinese researchers? Despite leading the world in the total

[8]Yongfei Zheng: Academician of Chinese Academy of Sciences, Editor-in-Chief of *Science in China: Earth Science.*

number of published papers, why do China's STM journals fail to attract world-class manuscripts from Chinese scientists? Scientific papers are an external manifestation of scientific and technological achievements, and STM journals serve as their carriers. What impact might the changes in the number and citation rates of China's sci-tech papers have on China's STM journals?

4.2.1.1 The "Triple Attributes" of STM Journals

STM journals possess three distinct attributes – essential, professional, and industrial. These threefold attributes determine that STM journals meet the diverse needs of different groups of people.

The essential attribute of STM journals address the personal needs of both readers and authors. STM journals have substitutable functions in documenting and disseminating scientific research results. By reading these papers, readers can obtain knowledge and stay up to date with the latest developments in their fields. On the other hand, authors gain recognition and validation from others or organizations by publishing their papers to manifest their research results. However, Chinese STM journals should not only improve the content quality, review quality, publication speed, dissemination capability, and overall impact but also enrich the academic depth and connotation, so that the gap can be effectively narrowed in the international competition of STM journals. Without these enhancements, it would be challenging to attract high-level readers and authors.

The professional attribute of STM journals corresponds to the needs of groups such as researchers and librarians. Back in the 1990s, I was conducting research in China, when I wanted to learn about the latest findings of international research, I often asked my friends abroad to post me paper journals. With the transition of STM journals from the print to the digital era, libraries have made access to information easier and faster for researchers through purchasing databases and other resources.

The industrial attribute of STM journals addresses the profitability needs of publishing entities such as publishing houses or publishing groups. At present, China lacks highly internationalized academic publishing groups, and the profits earned from international academic publishing are limited. Nowadays, many English-language STM journals in China adopt a strategy of collaboration with large-scale international publishing groups, colloquially known as "borrowing a ship to go to sea". This model, however, displays a notable flaw, as the absence of international management in journal publishing remains a significant drawback for Chinese publishers. In contrast, international STM journals demonstrate explosive growth, reaching every corner of the scientific community by publishing "series of journals". With their mature technology platforms, globalized databases, and internationalized management capabilities, international publishers are quite aggressive in launching new journals and attracting high-quality journals to join their portfolios.

In the era of the digital economy, integrated innovation is the opportunity and a new growth point for the development of STM journals, while scientific management and advanced technology are essential in promoting STM journal development. At present, it is necessary to promote the integration of traditional and emerging publishing. This includes innovating the concept of journal publishing, enhancing knowledge services, and establishing a modern communication system so as to promote the deep, integrated development of STM journals.

4.2.1.2 Integrated Innovation Practices of China's STM Journals

In terms of integrated publishing, *Science China Earth Sciences* is actively exploring ways to leverage its advantage in traditional publishing and transition from a publishing service to a knowledge service.

Firstly, *Science China Earth Sciences* innovates content resources based in China and facing the world. The journal publishes articles written by Chinese authors as the first or corresponding authors in both Chinese and English in order to meet the needs of a wider audience. Additionally, it has established its own brand of academic conferences, such as the "Forum on Earth Science Frontiers," where top-tier experts are invited to deliver academic reports that are later published after being peer-reviewed.

Secondly, *Science China Earth Sciences* places emphasis on building strong academic and publishing teams while clearly defining their roles and responsibilities. The journal aims to integrate the talents from publishing units and scientific research institutions, cultivate thesis editors and emerging publishing talents, and foster a talent team for integrated development. The editorial board undertakes the task of organizing submissions to special issues and ensuring content quality. Moreover, with their identities made public, the editorial members bear the responsibility for the academic quality of the journal. Meanwhile, the publisher assists the academic work of the board and is responsible for checking weights, editing, and publishing, market operations, news releases, platform development and maintenance.

Thirdly, the journal is committed to establishing a modern communication system for integrated development. Nowadays, the traditional and single way of reading printed articles no longer meets readers' personalized demands, *Science China Earth Sciences* actively explores diverse communication channels and forms. It promotes a shift from "timed" production and communication to "instant" ones. Promotional channels such as WeChat accounts, video accounts, and institutional blogs have been established to present the journal content to researchers in various forms, including graphic introductions, audio recordings, video academic reports, etc.

In addition, *Science China Earth Sciences* embraces cutting-edge technologies and innovative management strategies in its publishing operations. Using new technologies, traditional publishing content can be disseminated across multiple media platforms after one single production, realizing cross-media publishing and communication. There can be multiple creative ideas for one piece of content, achieving the effect of mobile dissemination. There are also various presentation forms for one product, realizing the effect of video-centric and interactive dissemination. Additionally, various functional modules have been optimized to streamline the publishing process. These modules include manuscript submission and review, content plagiarism check, process and email customization, real-time publishing, fragmented reading, and personalized alerts.

4.2.1.3 Advice to Promote STM Journals' Integrative Innovations

Under the background of a rapid increase in research output resulting from the enhancement of our country's comprehensive national power, China's STM journals should actively align with the national sci-tech development demands. They should promote concerted efforts among multiple stakeholders, striving for breakthroughs with integrative

innovations and actively expanding their living space. To achieve this, the following measures are recommended:

(1) Enhancing the management capabilities of STM journals
Establish funds for the development of STM journals, guiding journals to adopt an international perspective, enhancing and strengthening a group of influential Chinese language and English language journals, thereby creating STM journal brands with global impact.
(2) Encouraging competition among China's STM journal publishers
Promote healthy competition among different publishers in areas such as technology R&D, journal M&A, and integrated development, continuously enhancing their market operation and technical development capabilities to build the top-tier journal publishers all over the world.
(3) Establishing knowledge service platforms for STM journals
Benchmark those international platforms that integrate manuscript submission and review, global publishing and dissemination, scientific big data services, and cross-national academic evaluations. China's STM journals should realize the transformation and upgrade of the business model through integrated development.
(4) Prioritizing the construction of talent teams for STM journals
Increase funding subsidies for outstanding talents engaged in STM journal operations, particularly professionals with expertise in scientific news writing, new media operations, and technology development. This will enhance the capabilities required to effectively manage STM journals.

The call for Chinese scientists and engineers to base their research on the land of China does not mean that they cannot publish papers in international journals. Instead, it represents new requirements for Chinese researchers: not to rush towards hot research topics blindly but to conduct research that truly aligns with China's demand, and dare to make their voices on methods, models, and theories led by China. In the future, furthermore, we should work even harder to effectively operate STM journals with extensive academic impact and promote the flourishing development of academia through journal construction.

4.2.2 Bin Peng: Enhancing Publishing Service Capabilities to Facilitate the Construction of First-Class Journals[9]

In the digital economy era, scholarly publishing has undergone qualitative changes, namely, STM journals have fully transitioned from print to digital; papers are moving from periodical publishing to individual article publishing; the concept of first release is also gradually shifting from being published in a print journal to first released online; literature services are evolving from the delivery of original texts to knowledge services; the business model is transferring from traditional subscription to open access (in 2020, for the first time the number of globally published open access papers exceeded the number of those published under traditional subscription models).

[9]Bin Peng, General manager of China Science Publishing & Media Ltd. (Science Press), Senior editor.

4.2.2.1 Traditional Scientific Publishing Must Transform into Knowledge Services in the Digital Era

The traditional model of scientific journal publishing primarily revolves around the publishing of print journals to serve authors and readers. However, with the rapid development in networking, information technology and digitization, there have been significant changes in the carriers and dissemination methods of STM journals.

International scientific publishing groups have shifted their publishing models from the traditional linear process of editing, printing, and distribution to the model of leveraging modern platforms and tools. The new publishing model runs through the entire publishing process and then integrates into and serves the whole scientific research cycle, including a complete set of closed loops of content production and knowledge management from the authors' grant applications and research project initiation all the way to author value-added services.

In recent years, publishing service capabilities have become the core competitiveness for publishing enterprises with accelerated innovation of cutting-edge technologies such as 5G, big data, cloud computing, Internet of Things, and AI. Since the outbreak of the COVID-19 pandemic, the global STM journal publishing industry has swiftly responded to the new demands of making scientific research results easily accessible, openly shared, timely published, and reliable. Considering this, the industry has actively adjusted its strategic layout to promote the free and open sharing of COVID-19 scientific research resources.

"Knowledge service" actually refers to a type of service that revolves around providing knowledge content and solutions tailored to the needs of users. The transformation of traditional scientific and technological publishing into knowledge services has emerged as a crucial development pathway towards the upgrade of the scientific publishing industry.

4.2.2.2 Actively Establishing a Whole-Flow Digital Publishing Platform with Independent Intellectual Property Rights and Brands

With the evolution of digital publishing and the demand for academic exchanges, the capacity building in the publishing services of China's STM journals has received unprecedented attention and achieved rapid development. In order to establish a whole-flow digital publishing platform with independent intellectual property rights and brands, numerous domestic publishing organizations have been actively exploring various measures to advance the construction process. While having journals published and disseminated on foreign publishers' platforms through collaborations (usually called "going overseas by borrowing boats"), journal publishers in China are taking various measures such as developing their self-owned platforms to host their journals (also referred to as "building boats to go overseas"), commissioning a third-party to develop platforms which can host journals (called as "commissioning boat building") and even acquiring international platforms or publishers to publish journals internationally (known as "buying boats to go overseas") simultaneously to construct publishing and disseminating platforms.

Science Press, one of China's representative journal publishers, has built its own end-to-end digital publishing and knowledge service platform –SciEngine ever since 2014.

This platform integrates peer review, structured production management and network release capabilities. It has been seamlessly connected to leading international journal retrieval platforms, academic social platforms, search engines, etc. As a result, SciEngine enables promotional services such as targeted advertisements and customized reading. In order to make full use of digital technology and tools, Science Press has also teamed up with artificial intelligence laboratories to carry out a number of embedded AI services and cooperation, such as iFLYTEK's automatic translation between Chinese and English, the "fast paper reading" video generating, one-stop plagiarism checking, automatic referee recommendation, and knowledge graph applications. This leverage of AI has created a new mode of innovative development in the digital era. After years of development, SciEngine has become increasingly sophisticated and is now capable of providing a wide range of services for domestic and international STM journals including manuscript submission and review, soliciting contributions, production and publication, release and dissemination, journal evaluation and analysis, and academic marketing and promotion. In August 2021, "Notice on the Promotion of Using SciEngine the End-to-End Digital Publishing Platform of STM Journals" was issued by the Bureau of Scientific Communication of CAS to relevant units and various journal editorial offices attached. At present, the platform has aggregated 368 journals (including 200 English journals and 148 OA journals), with over 30 million pageviews in total.

The construction of journal publishing capabilities and academic exchanges mutually reinforces one another. The publishing capabilities of China's STM journals have not only withstood the test and challenges during the COVID-19 pandemic but also have been enhanced through comprehensive publicity and promotion. These have in turn facilitated high-level academic exchanges and innovation.

4.2.2.3 Reflections and Suggestions on the High-Quality Development of China's STM Journals

Currently, China is in dire need of the establishment of new regulations and institutional frameworks to manage the open access to STM papers, open sharing of scientific data, open academic service platforms, and participatory scientific research activities. Suggestions regarding the editorial and publishing services as well as the high-quality development of China's STM journals can be summarized into the following six aspects: regulating institutional standards, promoting clustered development, realizing technology empowering, accelerating mergers and reconstructions, building first-class journals, and creating service teams.

4.2.2.3.1 Regulating Institutional Standards and Enhancing the Capability of an Integrated Digital Publishing Service

There still exists a gap regarding publishing processes and standards between China's STM journals and international top-tier journal publishing services. To better promote international development, China's STM journals urgently need to regulate relevant international standards. Providing authors, readers, reviewers, and other users with professional, detailed, and procedural publishing service guidelines is essential to better serve scholars and users both at home and abroad.

4.2.2.3.2 Promoting the Clustered Development of Journals and Enhancing the Professional Service Capabilities via Platforms

The current state of development of China's STM journals can be described as "small, scattered, and weak". Although China's STM journals offer services comparable to those abroad, the overall level of professionalism in services is inadequate, and there are significant differences in the depth and effectiveness of the services provided. In order to address this, China should accelerate the clustered development and enhance the clustered level of STM journal services relying on digital platforms with independent intellectual property rights. This will further elevate their level of professionalism in services.

4.2.2.3.3 Enabling Technology Empowering and Integrating the Entire Research Process with the Help of Professional Tools

The mission of STM journals extends beyond merely presenting excellent research results. With the development of technology and the explosive emergence of information, the direction of development for STM journals must be knowledge service and providing support for scientific advancement and technological innovation. Therefore, in the process of serving technological innovation, STM journals should place more emphasis on utilizing the power of platforms and technology to create services that are of a higher level and more personalized. They should integrate into the entire research process to enhance the value of their services.

4.2.2.3.4 Accelerating M&A and Enhancing the Capacity for Large-Scale Service by "Buying Ships to Go to Sea"

Large international publishing groups rapidly expand their scale and reap the benefits through mergers and acquisitions. This strategy not only allows them to grow in size but also improves their publishing service processes and enhances their core competitiveness. It has become evident that simply acquiring other entities can lead to the desired expansion in scale. In the current landscape, leveraging the "buying ships to go to sea" approach to increase the capacity for large-scale service is out of the demand for China's STM journals to address their shortcomings and enhance their publishing service capabilities. Moreover, it is also a crucial step for Chinese publishing companies to embark on a global journey. In order to achieve these goals, pursuing M&A is both efficient and feasible in the current stage.

4.2.2.3.5 Building First-Class Journals and Promoting the Quantitative and Qualitative Rise of High-Level Academic Journals

In recent years, China has achieved substantial progress in the construction of first-class STM journals, however, there is still ample room for improvement in the overall service capabilities. Today, there are several feasible initiatives to revitalize existing journals. These include stimulating their vitality and increasing the number of high-level journals and the volume of published papers; increasing the number of new journals, enhancing efforts to launch new high-level new journals and encourage the participation of high-level scholars and leading research institutes; to introduce journal portfolios, encouraging outbound M&A by Chinese publishers and guide the collective return of journals without China National numbers.

4.2.2.3.6 Building Service Teams and Boosting the Coordination Ability to Invigorate Expert Resources

Currently, it is imperative to optimize the structure of the journal publishing team in our country. The truly successful international academic publishing must reach all over the world and must be operated and managed by talents globally. The key to the competitiveness of journals lies in having a high-quality and professional editorial team. Hence, we need to build a top-tier team of editors with various disciplinary backgrounds. Only in this way could we better enhance the core competitiveness of our journals.

Looking into the future, China's STM journals should continue to fully implement the new development concept, accelerate the promotion of high-quality development, build China's own high-end academic publishing platform brands and speed up the integration into the self-reliant and self-improving system of high-level STM journals by delivering a first-class level of service.

4.2.3 Yanchun Wang: Springer Nature: Applying Knowledge for a Sustainable Future[10]

As a publishing house with a history spanning over 180 years, Springer Nature has been committed to promoting exploration and discovery. The changes in its publishing mode have experienced three phases over the past 25 years, each marked by significant transformations. The first phase revolves around the transition from traditional paper-based publishing to digital platforms, which has radically transformed the information carrier and the reading habits of individuals. The second phase encompasses a shift in business models: over the last two decades, there has been a notable move from subscription to open access. After the obstacle for research to be discovered, used, and shared was eliminated, there was a reform in the method of knowledge dissemination. The third phase entails a transformation in the provision of products and services, transcending the mere offering of content service into solutions covering the entire research process.

Against the background of continuously growing digitalization and technological development, we have been thinking how to grasp the opportunity to construct a diverse ecosystem of academic services which can help researchers and institutes to enhance their efficiency, evaluate research results spread dissemination of scientific discoveries widely. These reflections can be summarized in three key aspects: openness, intelligence and sustainability.

4.2.3.1 Openness

Springer Nature is promoting the development of open science, enabling everyone to immediately read, share, use and reuse research findings to advance discoveries. We are committed to publishing more than 50% of original research in open access by 2024. In fact, at the end of 2021, Springer Nature became the world's first publishing institute to have released one million gold open-access original research and review articles.

[10]Yanchun Wang, Managing director of Springer Nature Greater China.

The benefits of publishing scientific papers in open access are evident, with both downloads and citations of papers increasing, and the impact of research findings extending far beyond the academic community. However, the concept of open science encompasses much more than just open access to articles. Our goal is to open up every aspect of the scientific research process, to achieve a transition towards open science and open research, in order to maximize the utilization of research resources.

Since the outbreak of COVID-19 pandemic in 2020, Springer Nature has published more than 24 000 new COVID-19 articles and has enabled free access to over 70 000 articles and book chapters freely available to the public. Open access to research and knowledge has enabled the development of vaccines at a record-breaking speed and has also provided a solid foundation for policy making.

4.2.3.2 Intelligence

The application of new technologies has revolutionized the landscape of academic publishing, leading to the digitalization and intellectualization from content to knowledge services. The integrated development of academic publishing and technology has driven Springer Nature's digital transformation: over 90% of journals have already been digitized, and the digitization transformation of books is also underway, with two-thirds completed. These contents are downloaded billions of times annually.

To address these challenges, Nature Research Intelligence, a groundbreaking AI-led service, has recently been launched. Leveraging innovative AI technology and drawing from over 150 years of editorial expertise from *Nature*, this service aims to assist research decision-makers in academia, government, and business organizations to make well-informed and data-driven funding and strategic decisions so that research investments yield more substantial influence in the social economy.

4.2.3.3 Sustainability

As one of the world's largest publishers of scientific research and educational content, Springer Nature has developed a program focused on the SDGs, signed the UN Sustainable Development Goals (SDGs) Publishers Compact launched by the United Nations and the International Publishers Association (IPA) in 2020. By actively partnering with various organizations, Springer Nature aims to explore the role of research in accelerating progress towards the SDGs. Since the launch of these goals in 2015, Springer Nature has published over 300 000 related research papers or book chapters.

In April 2021, Springer Nature became the first publishing organization to sign the *Climate Pledge*, committing to achieving net-zero carbon emissions by 2040. Launched in 2012, *Nature Climate Change* is the most cited journal in the field of climate change.

In 2019, Springer Nature initiated the "China New Development Award". The awarded books cover a number of hot topics, such as climate change, offshore energy, ecological environment, urban and rural development, earthquake prevention and disaster reduction, the "Belt and Road" countries, infectious disease prevention and control, education policies, artificial intelligence, industrialization in developing countries, as well as the current challenges and dilemmas of globalization. The award serves to share China's governance

experience, which comprehensively reflects China's important research contributions to the promotion of SDGs in these areas.

Over 180 years, Springer Nature has been seeking to advance discovery and serve the entire research community. We look forward to more future collaborations with the Chinese research community and partners to bring policymakers and practitioners closer to researchers in order to make significant progress towards the SDGs and solve various challenges and global issues.

4.2.4 Yanwen Li: To Excel in the Content and Dissemination of STM Journals in the Era of Digital Economy[11]

Digital technology, while posing significant challenges to the traditional publishing model of STM journals, also brings new opportunities for development to the digital era. The deep integration of traditional and new media has fundamentally transformed the original publishing model of STM journals, including content organization and dissemination models. Things that were once unimaginable and unachievable can now be realized. The presentation of scientific articles is no longer limited to plain text and static graphics. Moreover, the dissemination channels extend beyond printed journals. All contents relevant to the articles can become their organic parts, all digital communication methods and channels might become their dissemination platforms. By data mining, constructing knowledge service platforms, and implementing augmented and priority publishing, the publishing cycle of scientific papers can be significantly shortened. This results in a larger amount of information, a greater variety of presentation. Moreover, since the dissemination spreads faster, covers a wider range and has increased effectiveness, the application value of scientific articles become larger, and thus the roles they play bigger. As a result, exploring how to realize the maximum value of scientific articles harnessing digital technology is of significant importance.

In reality, scientific and technological papers serve as the primary method for STM journals, particularly academic journals, to fulfill their functions and roles. However, this is not the sole approach, especially for technological journals. The mission of technological journals is to serve the promotion of sci-tech progress in the industry, facilitate the transformation of sci-tech achievements, and cultivate applied talents, and primarily cater to applied professionals as their main readership. The main mission of applied talents lies in utilizing scientific and technological knowledge and skills to solve practical problems and facilitate the application of sci-tech achievements instead of seeking scientific discovery and knowledge creation. This also determines that the content they need is far more than just articles They require technical solutions and other content that meets the demands of their practical work, content of knowledge and skills to enhance personal abilities. Moreover, they seek information on the latest trends, hot topics, and dynamic news such as industry developments, technological advancements, and market demands. Therefore, for technological journals to play greater roles, they need to be user-needs oriented and provide products and services based on the preferences of the users.

[11]Yanwen Li, President of *Metal Working* from Machinery Industry Information Research Institute, senior editor.

Based on the understanding mentioned above, I believe that when exploring the academic publishing and media integration issues of scientific journals in the digital economy era, discussions should not be limited to just the dimension of research papers. It would also be more comprehensive and accurate to examine content and dissemination issues from the perspective of the content needs of the served audience according to the functions, roles, positioning, and characteristics of different types of journals.

In recent years, *Metal Working* has embraced a practice-oriented approach with some attempts made to promote media integration. Following the product layout concept of "productization, systemization, and branding", *Metal Working* has built an all-media content and communication service system providing print media, digital media, events, books and value-added services. The journal has gathered 1.9 million professional followers, opening up a path of media integrated development centered around digital media.

The journal utilizes the digital technology to empower the print media. For example, by embedding multimedia content in print content, we enrich the forms of content presentation and expand the capacity of reporting; relying on the digital platform to solicit and screen manuscripts, we enlarge the range of topics for print media; using the digital platform to disseminate content from print journals, we increase the value of dissemination, publicize the print journal and promote the targeted distribution of print journal.

In the field of digital media, the journal focuses on building an online content product system and establishing an online learning and communication platform.

(1) A WeChat matrix composed of ten accounts including "Metal Processing" has become a comprehensive communication venue that aggregates various contents and provides all-around services to the industry. At present, this matrix has more than 1.4 million followers, making it the largest WeChat platform in terms of both followers and influence in the industry.

(2) To meet readers' demands for systematic online learning and exchanging information on advanced technology, new products, processing solutions and practical experience, we have introduced three initiatives:
First, we launched the medium-length video column "Metal Working Fans Classroom," with each episode lasting about 40 min. There have been 161 episodes broadcasted so far, with the audience exceeding two million. In fact, some enterprises have even incorporated this program into their training courses.
Second, we launched the short video column "Little Metal Working Fans Classroom", focusing on one knowledge point in each episode, with 58 episodes released to date.
Third, we introduced the short video series "Really Wonderful Metal Working," which mainly presents advanced processing technologies, equipment, and technical tips, and has aired an impressive 691 episodes.

(3) To satisfy readers' demands for the latest technologies and products, we have implemented the following three strategies:
First, we live broadcast from significant exhibits at important trade shows, with over 40 exhibitions events broadcasted so far, resulting in more than 1000 videos.
Second, we make in-depth live coverage of key enterprises, with 43 live events conducted to date.
Third, we establish "Online Product Launching Ceremonies" to meet the needs of enterprises for online new product releases.

(4) In order to facilitate discussions on key application areas, we organized the "Online Forum", which has been held 29 times.
(5) To fulfill reader's demands for industry information, we established the "Metal Working Weekly" with the orientation of "focusing on industry hotspots and disseminating industry information", which has been broadcasted for 125 times.

In our exploration of advancing media integration, we have formed several insights. First, content is fundamental, as it is the basis of the media's communicative power, guiding power, influence, and credibility. High-quality content and efficient communication are the eternal topics of high-quality development of media. Second, technology plays a vital role in media integration. To serve their purpose effectively, media outlets must embrace and utilize new communication technologies, platforms, carriers, and tools. These advancements should be employed to enhance the delivery of quality content. Third, the users are the core asset of a journal, our service targets, and also our development foundation. Neglecting to adapt to the evolving demands of users will hardly better satisfy their demands. Last but not least, products serve as the backbone of media outlets. Any brilliant concept or idea must be realized through tangible products. Therefore, constructing a product system with content that meets user demands, clear operational processes and business models and competitiveness is crucial for the sustainable, stable development of STM journals.

4.2.5 Ning Ding: Building High-End Exchange Platforms to Facilitate the Construction of First-Class Journals[12]

4.2.5.1 Digital Publishing Serves as a Strategic Opportunity in the Construction of World-Class Journals

Digital publishing is experiencing a tremendous boom, revolutionizing the publishing industry and heralding the "change of the era". According to the *2020–2021 Annual Report on China's Digital Publishing Industry*, the industry's annual revenue surpassed one trillion yuan in 2020, representing a 19.2% increase over the prior year. High-quality published content is presented in various product formats and copyright forms, with a combination of publishing content, technology and cultural creativity, showing a clear characteristic of integrated development. In particular, STM journals have successfully transitioned from traditional paper publishing to digital and online publishing, showing the initial emergence of integrated publishing. Digital publishing and online dissemination have played a significant role in expanding the influence of journals and represent a historic opportunity for the development of journals.

However, we should also recognize that both opportunities and challenges coexist. Inadequate statistics reveal that comprehensive evaluation is conducted across eight sections of press and publication, encompassing book publishing, journal publishing, newspaper publishing, audiovisual product publishing, electronic publication publishing, printing and reproduction, distribution of publications, and import and export of

[12]Ning Ding, Executive vice Editor-in-Chief of *Engineering*, Director of Academic and Publication Office of Department Three of the Chinese Academy of Engineering.

publications. This evaluation analyzed operating revenue, added value, total output, and total profit, among other factors. The findings demonstrate a considerable gap between journals' revenue scale and that of electronic publications, even of book publishing. Notably, journals' revenue growth has remained stagnant, failing to fully capitalize on the opportunities presented by digital publishing and achieve significant progress.

4.2.5.2 Knowledge Services Become the Intrinsic Demand for Digital Publishing of STM Journals

In today's era, the demand for research data by scientific researchers serves as the intrinsic driving force behind the development and transformation of digital publishing in STM journals. This demand is primarily reflected in three aspects. First, the major challenge faced by scientific research has changed. In the age of knowledge explosion fueled by big data, "massive amounts of data" have increased the burden of resource acquisition, and data explosion has, in turn, led to a scarcity of knowledge. Second, scientific research increasingly relies on data as a crucial support. Data is no longer just the outcome of scientific research but has become the living foundation and tool of scientific research, the source and strength of innovation. Lastly, the research security and discourse power in science and technology are being challenged. The severe outflow of excellent scientific papers and data leads to the outflow of strategic resources in sci-tech information and intellectual property rights, which to some extent threatens the security of national sci-tech literature and data.

Under such circumstances, international scientific journal publishers have embarked on a transformative journey, shifting their focus from digital publishing and online dissemination towards knowledge services. As Darren Howell, VP Research Intelligence at Springer-Nature stated, "Never has it been more important and challenging to stay on top of scientific discoveries and what they mean for research direction". A notable example is the knowledge service called Nature Research Intelligence launched by Springer Nature. This service helps research decision-makers from academic, government and corporate organizations make informed data-driven funding and strategy decisions. Meanwhile, Elsevier, the world's second-largest journal publisher, has positioned itself as a "global information analytics company", dedicated to providing customized reporting, multidimensional integrated research, data delivery, and web integration services to policymakers, funders, academic institutions, and corporate research organizations worldwide.

4.2.5.3 Construction of High-End Exchange Platforms is the Necessary Way for the Development of STM Journals

The 14th Five-Year Plan has outlined the goal of constructing a high-end exchange platform for national scientific research papers and sci-tech information. This plan paves the way for the establishment of a digital publishing and knowledge platform for STM journals. The term "high-end" in this context is reflected in the following aspects. Firstly, high-end resources, the platforms include not only fundamental resources such as literature and scientific data but also knowledge resources that are generated through organizational connections. Theses should be strategic resources of high value, or resources that can lead the development of industries and disciplines. Secondly, "high-end" also signifies the

adoption of advanced technology throughout the entire process of resource processing, correlation revelation, intelligent retrieval, analysis, and mining. Traditional information technology is combined with modern intelligence, enabling continuous upgrades. Thirdly, the "high-end" nature of the platform extends to the quality of services provided. In addition to offering literature and intelligence services, the platforms aim to deliver knowledge services which are solution-oriented. Moreover, the notion of "communication" within this context encompasses various dimensions. First, the communication is carried out in two ways to realize the communication between suppliers and demanders, between individuals, between individuals and the system, and between systems. Second, the communication is international to realize multi-language services. Third, the platforms should enable the communication between research literature and sci-tech information. In this way, the resources can be aggregated, integrated, mined and used across different fields, departments, regions, systems, and types.

The Chinese Academy of Engineering led the construction of the China Knowledge Centre for Engineering Sciences and Technology (CKCEST), making some explorations on high-end communication platform development. CKCEST is oriented as a national non-profit open knowledge resource aggregation and service platform in engineering sciences and technology. CKCEST is committed to building a centrally managed and jointly operated knowledge service platform which aggregates and integrates China's data resources in engineering sciences and technology. Currently, the platform has established 30 branch centers dedicated to specific fields such as materials science, geographic information, oceanography, aerospace, chemical engineering, environmental engineering, transportation, forestry, energy, agriculture, water conservancy, information technology and health care. These branch centers not only provide robust information support but also offer valuable knowledge services for crucial decision-making processes in national engineering science and technology. Moreover, they also play a vital role in major engineering scientific activities, enterprise innovation, and talent cultivation.

The Academic Guiding Sub-Centre stands out as a specialized hub designed to cater to the needs of scholars. With a focus on digital publications like *Engineering* and other high-quality resources sourced from the academic conferences of the Chinese Academy of Engineering, this center offers a range of online communication services. These services include online communication services such as the creation of personal academic homepages for scholars, the aggregation of experts' research results, instant academic sharing, and scholars recommendations based on the journals' papers, etc. In addition, combining services such as offline conference organization, derivative online conference live broadcasting, conference website building, conference call for papers, academic exchanges are made more swift, convenient, and accessible. The ultimate goal is to facilitate the flourishing of online academic exchanges, all while bolstering the value-added services in journal publishing.

In conclusion, the digital publishing platforms for STM journals are undergoing a rapid transformation, shifting from merely disseminating information to providing comprehensive knowledge services. This transformation requires us, in the process of digital publishing platform construction, on the one hand, to improve the standards and capabilities of digital publishing, to better aggregate the existing open data publishing resources, and realize the deep integration between various journals and resources from various fields, and build national-level scientific research data platforms; on the other hand, through the support of

AI and other underlying technologies, to realize offering services such as deep data mining, knowledge mapping, hotspot tracking, and trend prediction and ultimately, to realize in-depth services from data to information to knowledge.

4.3 Suggestions for the Development of China's Scholarly Communication Platforms in the Era of Digital Economy

4.3.1 Yuanchun Zhou: Scientific Data Publishing in the Era of Digital Economy[13]

For the first time, the fourth plenary session of the 19th CPC Central Committee proposed that data should be recognized as a factor of production participating in distribution, and explored the establishment of a sound mechanism wherein the market assesses contributions and remunerations are determined based on those contributions. Entering the 21st century, data, as a key element of the digital economy, has shown a trend of experiencing explosive growth and massive accumulation, emerging as a crucial force for driving innovative development. Scientific data, in particular, has gradually been recognized for its role and position as a fundamental, strategic and key resource for promoting economic and social development. Scientific data publishing, as a main approach to open scientific data, refers to the release of data and datasets that have undergone quality peer-review through certain mechanisms, thereby allowing the public to access and use these data (sets) as they wish. By implementing quality control measures such as peer review of data and its associated papers, scientific data publishing safeguards the credibility and legal rights of data producers and owners, maximizing the value of research data. In 2018, the "Measures for the Management of Scientific Data" (hereinafter referred to as "the Measures for Data") were distributed by the General Office of the State Council. Among which, Article 22 explicitly stipulates that "the competent departments and legal entities shall actively promote the publication and dissemination of scientific data, and support researchers in organizing and publishing scientific data, which is clearly owned, accurate, complete, and of high sharing value".

The government-led open sharing of scientific data mainly emphasizes the compulsory collection and sharing of scientific data resources generated by state-financially supported research projects, focusing on the public good attributes of scientific data. However, it overlooks its multiple attributes, such as the intellectual input from research institutes or researchers, which may result in insufficient internal motivation. This can affect the quality of scientific data submissions, as well as the types and quantities of resources. In contrast, scientific data publishing refers to the ecosystem of journal publishing and the dissemination system. With data at its core, this system leverages journal citation and evaluation mechanisms to explore establishing a comprehensive system encompassing data citation,

[13]Yuanchun Zhou: Deputy Director General of Computer Network Information Center, Chinese Academy of Sciences, Research fellow.

evaluation, and publication. Thus, data registration, management, storage, peer review, and publishing can be carried out. Leveraging the completeness and continuity of the traditional publishing system, it is important to ensure the intellectual property rights and acknowledgment of the contributions of researchers, thereby enabling the mechanism for scientific data publication to become self-sustaining. This approach provides a new mechanism and pathway for sharing scientific data services. Consequently, countries worldwide are actively engaged in developing infrastructure for the publication of scientific data.

The landscape of scientific data publishing is a complex one, characterized by the diversity of data types, varying metadata standards, and divergent interpretations and usage. As such, specific specifications and practices for data publishing are fragmented and subject to constant evolution. The components that make up the ecosystem of scientific data publishing, including responsible parties, publishing modes, incentives and penalties, citation and evaluation standards, and operational mechanisms, are still in a state of dynamic development. There are challenges such as the multitude of micro-policies of scientific data publishing institutions, but there is a lack of unified national-level policies and measures. Furthermore, an efficient and organic cooperation mechanism has not yet been established among the publishing entities, and there is a lack of enthusiasm among authors and users of scientific data publishing.

Therefore, China should face the major strategic demands of safeguarding national scientific data resources management, data security, and the development of related national industries. The core is to enhance China's overall capacity for scientific data publishing and management. Driven by promoting sustainable development, effective dissemination and utilization of scientific data resources, linked by the main line of integrating and sharing of scientific data resources, China should maximize the collection, preservation, processing, and optimal allocation of these resources, build a state-led information infrastructure for scientific data publishing and to form a soft environment for the academic dissemination of scientific data in which multiple subjects coexist and cooperate with each other.

4.3.1.1 Developing Implementation Rules for Scientific Data Sharing and Publishing to Provide Macro-Level Institutional Guarantees

The Measures for Data stipulate that competent departments and legal entities shall establish corresponding management systems to ensure that authors who published papers in foreign journals submit the scientific data supporting their papers' perspectives to their respective organizations for unified management. As a result, individual institutions can grasp this opportunity to develop specific implementation details based on the requirements outlined in the Measures for Data.

On 2nd April 2022. the National Press and Publication Administration (NPPA) proposed in the "Notice of the National Press and Publication Administration on Carrying out the Annual Verification Work for Periodicals in 2021" that the journal publication verification items include "whether the research data is processed and preserved" and "whether to recommend to authors the use of our self-developed data storage platforms (such as ScienceDB) for submission and sharing. On 17 November 2022, the General Office of CAST

and the General Office of CAS jointly issued "Notice on Organizing and Carrying out the Work of Submitting Journals' Article Related Data".

4.3.1.2 Strengthening the Construction of Internationalized and Clustered Scientific Data Publishing Platforms to Provide Credible Platform Support

Scientific data publishing platforms are important infrastructures to realize the long-term storage and accessibility of scientific data. These platforms are important for ensuring the discoverability and reusability of scientific data, guaranteeing the verifiability of scientific conclusions, and safeguarding the research integrity. The whole process of scientific data management involves multiple parties. Therefore, in order to foster open science and promote the sharing of scientific data, the construction of such platforms must adhere to the international principles of scientific data sharing and platform development, while also complying with laws, regulations, and policies relevant to data securities in China. Meanwhile, the UNESCO recommendation on Open Science aims to encourage international and multi-stakeholder cooperation in the context of open science to reduce gaps in data, technology, and knowledge.

To achieve this, the scientific data publishing platforms should prioritize networking and standardized construction. By doing so, it can connect all entities involved in the entire life cycle of scientific data. Moreover, the platforms should strive to enable open sharing of scientific data throughout the entire process.

4.3.1.3 Expanding the Empowering Effect of Scientific Data Publishing Through Comprehensive Data Elements

We should further exploit the potential value of data resources by offering specialized data services through technologies like data association, visualization, and data analysis mining. Additionally, we should also provide professional support services for scientific data (sets) searching and services for the reproduction of scientific research results. Provide proof of data inclusion, data publication certificates, data citation proof, data utilization proof, etc., to reinforce the positive incentives for data publishing. In order to promote the embodiment of scientific data value, ScienceDB is currently collaborating with relevant platforms such as the Common Science and Technology Resource Identification Platform[14] to explore scientific data impact evaluation services.

4.3.2 Zhixiong Zhang: New Measures for Global STM Journals and Correspondent Suggestions of China's STM Journals in the Era of Open Science[15]

Open science is deemed as a new science research paradigm building on essential principles of academic freedom, research integrity and scientific excellence[3]. This new paradigm emphasizes the importance of openly sharing research findings, promoting transparency in

[14] www.cstr.cn.

[15] Zhixiong Zhang: Deputy Director of National Science Library, CAS, Research librarian.

the research process, fostering self-regulated scientific activities, and ensuring the reproducibility of experiments.

Open science has a profound impact on all aspects of scientific research worldwide. For global STM journals, open science has essentially brought about a change in the paradigm of scholarly communication, which poses a number of challenges. To list just a few, STM journals are facing strong competitors for the dominance of scholarly communication, business models of STM journals are demanding to be reshaped; open peer review is causing STM journals models to lose the exclusive advantage of peer review; OA publishing requires STM journals to return more their rights and interests to the public and authors; the flourishing of new open scholarly communication platforms leads to STM journals no longer being the first choice for academic exchange; predatory OA journals aiming for high profits have drawn attention of academic community and so on.

In response to these challenges, many international STM journals have adapted and proactively embraced the changing landscape of academic exchange. They have recognized the inevitability of open science and have revamped their operations accordingly. By following open science recommendations, transforming traditional journal operation models around the process of open science, and formulating new measures, plans and models, these journals are striving to find their positions in the open science environment and enhance their values accordingly.

4.3.2.1 Proactively Adapting and Developing OA While Actively Exploring OA Publishing Models

After the emergence of the OA campaign, there has been a significant shift in STM journals from rejecting OA previously towards embracing OA publishing. With more than two decades of development practice, OA publishing has now become an integral part of the scientific publishing landscape.

At present, publishers specializing in OA journal publishing have gained a firm foothold and made great progress. For example, BMC (BioMed Central) boasts an impressive portfolio of 316 OA journals under its banner; MDPI (Multidisciplinary Digital Publishing Institute) prides itself on its 413 OA journals; Hindawi and Frontiers also have a substantial number of OA journals, with 243 and 184 titles respectively.

In addition to these specialized publishers, well-known international publishing groups are supporting OA publishing either launching OA journals or offering OA options for articles to be published. In 2022, both Springer Nature and Elsevier had nearly 600 journals supporting full OA. Notably, prestigious serial journals like *Nature, Cell,* and *Science* offered OA publishing options in 2021. Moreover, over 2700 of Elsevier's journals now enable OA publishing[4].

4.3.2.2 Proactively Embracing Preprint Release and Open Peer Review to Develop New Types of Scholarly Communication

International publishing groups have recognized the significance of preprint scholarly communication and have taken active measures to incorporate it into their publishing practices. They have invested in preprint platforms and initiated various strategies to seamlessly integrate preprint publication with their traditional journal publishing

processes. This innovative approach has led to the development of a new scholarly communication model, characterized by the release of preprints plus open peer review plus official journal publishing in the OA model.

One noteworthy example of this trend is Elsevier's acquisition of SSRN (Social Science Research Network) in 2016. Initially designed as a preprint platform for the social sciences, Elsevier transformed it into a research network that supports a broader range of disciplines, including natural sciences, engineering, and technology. In addition, Elsevier introduced the FirstLook service, which provides researchers with early access to cutting-edge research through SSRN[5]. In 2018, Springer Nature launched its preprint service – Research Square and introduced the "In Review" function on its OA platforms (*e.g.*, SpringerOpen and BioMed Central)[6]. In January 2020, Taylor & Francis acquired an open peer review platform F1000 Research, thus linking preprint release and open peer review with STM journal publishing[7]. In early 2020, Wiley launched its "Under Review", a service that allows authors to save their manuscripts as preprints on Wiley Atypon's Authorea at the same time as they formally submit their manuscripts to Wiley journals[8].

4.3.2.3 Lifecycle Support for Scholarly Service Needs in All Segments of Open Science

At the turn of the century, Annette Thomas proclaimed a new mission for publishers – to provide comprehensive support to researchers throughout the entire scientific research process[9]. In the past, STM journals were only responsible for the work from the manuscript submission to final publication. But now, they are actively involved in building a service system that supports the lifecycle of open science.

Digital Science, affiliated with the Holtzbrinck Publishing Group as Springer Nature, has broken down the scientific research process into various stages, including concept generation, research conducting, paper writing, manuscript submission, paper review and revision, paper publication, information sharing, and impact assessment[10]. To cater to each phase above, Digital Science has developed corresponding academic service products such as ReadCube, Labguru, Overleaf, Figshare, Altmetric, Dimensions, etc. These products seamlessly integrate into the entire scientific research cycle, providing researchers with essential support at every step.

Similarly, Elsevier has also deployed a product layout geared toward the entire lifecycle of scientific research. By repositioning existing products and acquiring innovative solutions, Elsevier has curated a product layout that revolves around three primary research stages with a total of 13 specific research scenarios. Concerning the above-mentioned research stages and research scenarios, Elsevier has also organized and optimized its ScienceDirect, SciVal, Scopus, SSRN, Mendeley, Bepress and other products[11].

4.3.2.4 Transforming from a Traditional Publishing and Content Selling Business to a Value-Added Content Provider, Developing Deep and Granular Specialized Knowledge Products

To better satisfy the demand for professional and in-depth knowledge in scientific research, some key STM journals and publishing institutions have undertaken extensive efforts to explore the value of their content resources. Through specialized sorting and editing of knowledge contents, they convert scientific papers into refined and expertly crafted

knowledge products, capable of delivering enhanced content value. This transition involves the shift from traditional practices of publishing and selling single-content papers to offering value-added content products through professional knowledge compilation.

One notable example is the American Chemical Abstracts Service (CAS), which has built specialized and detailed knowledge content databases by integrating scientific literature. Over recent years, with the application of AI technology, CAS has been actively promoting chemistry intelligence. By utilizing its extensive chemical expertise and highly structured chemical big data, CAS aims to develop artificial AI in chemistry, enhancing the accuracy of experimental result predictions[12].

Another publisher, Springer Nature, focuses on the developing databases to cater to specific research areas, for instance, SpringerMaterials, a curated database in materials sciences[13]; AdisInsight, a pharma discovery platform[14]; SpringerProtocls and Springer Nature Experiments, databases of laboratory protocols. Apart from a range of solutions supporting research intelligence[15] that we are familiar with, Elsevier, also developed a range of data products to support research management, expert finding, clinical support, medication decision-making, geological research, engineering and technology applications[16].

4.3.2.5 Refining the Functional Positioning of Journals from Publishers to Organizers of Peer Review and Certification

The in-depth advancement of open science has changed the way research results are published. More and more research findings are initially released on platforms like preprints and OA repositories. With the recognition that the primary value of journals lies in providing reliable, trustworthy, and high-quality research to the scientific community, some publications are redefining their functional positioning, focusing on peer review and certification instead.

eLife serves as a typical example of this shift. An internal analysis showed that nearly 70% of the papers under review were already available on preprint platforms such as bioRxiv, medRxiv, or arXiv[17]. It means eLife's transition from being a traditional publisher to an organization that reviews and certifies papers that have already been published.

In 2021, eLife announced that they were shifting to exclusively reviewing manuscripts that have been posted as preprints. Then, in October 2022, eLife announced that from January 2023, eLife would no longer make accept/reject decisions following peer review; on the contrary, eLife would publish all papers it reviewed as Reviewed Preprints on the eLife website alongside eLife assessment and Public Reviews. Depending on the situation, authors would then have the option to revise and resubmit their papers or ask eLife to declare them as the Version of Record (VOR). After authors proof their papers to meet eLife's author policies, they will be indexed by a variety of services, such as DOAJ, Google Scholar, PubMed, PubMed Central, Europe PMC, Scopus and Web of Science.

4.3.2.6 Building an Overlay Journal Publishing Model Based on Preprint Platforms

Overlay journals are a new type of OA scholarly journal. Unlike traditional journals, they don't have their own separate submission platforms. On the contrary, overlay journals rely on existing preprint platforms, repositories, or other public infrastructure to select papers for peer review.

Discrete Analysis is a typical example of an overlay journal. It is an electronic journal. However, its published articles live on arXiv rather than being hosted by the journal itself. The articles published are presented with "editorial instructions" and the arXiv URL linking to the articles. To be published in Discrete Analysis, the authors should first post their articles on arXiv, and then submit them from arXiv to the journal. The subsequent peer review procedures are conventional. Overlay journals not only reduce the operation and management costs to lessen the commercial burden of scholarly communication but also help increase the accessibility of published research results[18].

In addition to Discrete Analysis, there are also overlay journals such as the JMIRx journal series from OA publisher JMIR Publications which rely on preprint platforms such as medRxiv, bioRxiv and PsyArXiv.

Episciences is home to over 20 overlay journals[19]. These journals adhere to the FAIR principles – ensuring that the data they publish is findable, accessible, interoperable, and reusable.

4.3.2.7 Development Advice and Suggestions for China's STM Journals

Currently, open science has already become a global trend. International organizations, major scientific and technological countries, and scientific research organizations all recognise it as an important transformative strategy. They actively put forward policies and practices to promote the development of open science.

It is crucial for China's STM journals to embrace this trend, fully recognize the essential requirements of open science, and fully understand the essence of the scholarly communication model transformation. Firstly, it is important for STM journals in China to deepen their understanding of OA publishing and avoid seeking APCs only. Furthermore, these journals should adopt a platform-oriented mindset. By implementing a high-end exchange platform for scientific research papers and scientific information, they can create the infrastructure platforms and tools for open science. In addition, it is important to establish an exchange system mentality for promoting collaborations between journals and preprints, open data repositories. In this way, STM journals can integrate into the open scholarly communication system of relevant disciplines. STM journals should shift their focus towards providing value-added knowledge services. Rather than selling content, they should offer lifecycle open science services. Lastly, STM journals should prioritize peer review and certification procedures, delivering reliable, trustworthy, and high-quality research results.

4.3.3 Mingshen Zhang: The Connotation of the Digital Economy and Its Relationship with Academic Publishing and Communication Platforms[16]

China's *14th Five-Year Plan for the Development of the Digital Economy* highlights the growing significance of the digital economy in restructuring global factor resources,

[16]Mingshen Zhang: Deputy director of Enterprise department at Institute of Economics, Academy of Macroeconomic Research, Associate Research Fellow.

reshaping the global economic structure, and transforming the landscape of global competition[20–22].

4.3.3.1 What is the Digital Economy

The digital economy is, in essence, an economic form in which data becomes a key production factor.

First, key production factors have a threshold characteristic and must meet certain threshold conditions, which vary by industry.

Second, it is important to note that not all data can serve as a factor of production. Only cleaned, modeled, and driving business data can truly be considered useful for this purpose. Data, as a factor of production, possesses multiple characteristics. It has the accumulation of quantity, the integration of functions, the separation of ownership, the liquidity of use, the value of transactions, and the security of information. To achieve high-quality economic development, it is necessary to fully leverage the driving potential of data elements, such as new technologies and platforms, innovative products and services, as well as new models and new business forms. Additionally, data elements have the potential to empower at macro, middle, and micro levels, while also enabling data to turn into assets and capital.

Finally, it is important to recognize that the digital economy is not simply the sum of a few industries. The National Bureau of Statistics classifies the digital economy and its core industries into five categories: digital product manufacturing, digital product services, digital technology application, digital factor-driven industry, and the industry of digital efficiency improvement. The first four categories are the core industries of the digital economy, and the fifth category the "industry of digital efficiency improvement", refers to the industry relevant to the digital economy and is formed during the process of the digital economy's integration and empowerment to other fields[23, 24]. Therefore, the form of digital economy is not a simple addition of one or two industries. It has its own unique part, but also the part of digital economy to empower other industries.

4.3.3.2 How to Understand the 14th Five-Year Plan for the Development of the Digital Economy

The Plan analyzes the status quo and the latest developments in the digital economy. It offers the guiding ideology, basic principles and development goals for the development of the digital economy in the next five years. Moreover, it presents specific recommendations and corresponding measures to ensure progress in eight key areas, including optimizing and upgrading digital infrastructure, giving full play to the role of data elements, vigorously promoting the digital transformation of industries, accelerating the promotion of digital industrialization, continuously enhancing the level of digitalization for public services, improving the governance system of the digital economy, focusing on strengthening the security system of the digital economy, and effectively expanding the international cooperation of the digital economy[25, 26].

The digital economy has greatly impacted academic publishing and digital platforms, and there are two key areas that require particular attention. First and foremost, it is crucial to actively promote the digital transformation of the industry. This refers to

transforming the whole publishing industry, including upgrading the industrial chain structure, developing community resources, and exploring markets in lower-tier cities. Particular attention should be paid to the balance between industrial and public subjects. Regarding what kind of mechanism and profit-making model should be adopted to realize the operation, there should be corresponding regulations for different kinds of publications and the nature of publications. The second aspect is the continuous improvement of the public digital level, which is especially relevant as a considerable portion of academic publishing has public properties. The question of where the publishing industry gets involved in enhancing the public service level of digitalization deserves consideration.

4.3.3.3 Perceptions of Academic Publishing and Communication Platforms in the Age of Digital Economy

Academic publishing is an important link in knowledge generation, making it an integral part of the national innovation system.

The concepts and principles of scientific prioritization, peer review, archiving, and dissemination pioneered by the *Philosophical Transactions of the Royal Society* have always been the norms of academic publishing. Regardless of whether it is digital or print publishing, the most important thing is to return to the original intention. The original intention of academic publishing is evaluation and dissemination.

In the past 30 years, international academic journal publishing has been developed from the old "three elements" of typesetting, printing, and distribution in traditional print editions to the new "three elements" of ORCID, DOI, and open platforms nowadays. These new elements have steadily gained prominence, with academic social media, preprints, knowledge services, and digital publishing platforms emerging as important players.

The rapid development of digitalization has brought disruptive changes to academic publishing. First, the digitalization of products has led to the digitization of the entire publishing process of the whole industry, and on the other hand, it has given birth to a new generation of academic publishing service technologies. Secondly, the business model has changed from subscription to open access. The interconnectedness of open access platforms facilitates the sharing, accessibility, and assessment of data under certain rules, potentially making it the main space, channel and judge for academic communication and evaluation[27].

Looking at some future policy directions for the digital publishing industry at this point in time, there are two issues that deserve attention. The first is the healthy development of the academic literature database service market, including further strengthening the coordination of competition policy with science and technology policy, research policy, and copyright policy; actively introducing competition, fostering competition, and supporting competition in the academic literature database market; comprehensively applying a combination of hard and flexible regulatory measures and further strengthening the administrative guidance of large-scale databases; and actively studying and exploring the establishment of public welfare academic platforms to realize the organic combination of public welfare and marketization. The second consideration is the construction of scholarly exchange platforms. Popular knowledge service platforms such as iget, also have attributes similar to publishing. Therefore, the key to the development of scholarly communication platforms depends on how to make them healthy and sustainable endogenous platforms.

This may be a potential starting point for competition among different enterprises in the publishing industry in the future.

Generally speaking, China's academic journal publishing should catch up with the wave of national development of the digital economy and international progress of open science. Emphasis should be placed on accelerating the pace of data sharing, utilization, and evaluation. It is also essential to develop new generation copyright authentication and protection, data storage and dissemination technologies. Ultimately, we should promote open access in the real sense through the overall digitization of academic publishing.

4.3.4 Shuai Yan: Three Key Issues in the Development of Digital Economy of Academic Journals in China[17]

4.3.4.1 Digital Products

The digital products of academic journals form the cornerstone of the academic journal digital publishing industry and are the premier for the digital economy of academic publishing.

In the 1990s, major international academic journal publishers embarked on a digital transformation. Today, digital journal products have overwhelmingly dominated the market. *STM Global Brief 2021: Economics and Market Size*[18] pointed out that "digital continues to dominate the global market as a format, now accounting for as much as 89% of the scientific and technical segment in 2020, representing a 10% increase on 2019". From the perspective of operation and utilization, it is an indisputable fact that the market share of print journals has been decreasing year by year and has even been gradually withdrawn from the market in some disciplines and regions.

The emergence of the open-access movement since the beginning of the 21st century has introduced a new business model for academic journals. Increasingly, products in digital form are shifting to individual papers as the primary unit of publication, and the use of journals by academic institutions and readers is directly targeted at individual papers. At the same time, the traditional paid subscription model, which includes print and database forms, and sales by volume (issue) or by database, is facing growing challenges.

Regarding the digital presentation and distribution of academic journals, China did not start too late. CNKI has included more than 8580[19] Chinese academic journals, almost including all existing Chinese language academic journals in China. In other words, with the self-built website added, the publication of academic journals in China has basically realized digitalization. In addition, the degree of open access to academic journals in China is relatively high. Taking STM journals as an example, according to a survey out of 4,963 STM journals listed in the *Blue Book of China's STM Journal Development (2021)*, 1810 were OA journals, accounting for 36.47% of China's total STM journals. However, the range of digital products for academic journals in China is still incomplete. The admission and management of purely digital (or "launched digital") journals have yet to be resolved,

[17]Shuai Yan, Academic publishing advisor, Senior editor.

[18]https://www.stm-assoc.org/wp-content/uploads/2022_08_24_STM_White_Report_a4_v15.pdf.

[19]https://kns.cnki.net/kns8?dbcode=CFLQ.

and many publishing units still present their journal products by "issue" rather than by "article". The open-access business model is far from established.

With the rise of open science, the digital offerings of academic journals will become even more diverse, not just in terms of journals and papers themselves, but also their associated scientific data and other related materials.

4.3.4.2 Digital Management

The first area of focus is journal management. China has developed a journal management system and methods adapted to its own national conditions. Examples include the approval system, the sponsoring and hosting system, and the territorial management system. These measures have provided a fundamental guarantee for the flourishing of academic journals in China. In today's digital economy, the editing and publishing of academic journals have already realized the all-around digitization of the whole process, and the digitization of journal management should (and can) keep up with the pace of the times.

The second area is thesis management. From publishing administrations to specific journal publishers and academic institutes that publish and use papers, journals are still commonly referred to and focused on. In the age of digital publishing, academic journals present their audiences with individual papers that are supported by their brands. These papers may appear in a particular issue, or they may appear independently as individual papers, and the chances of the latter appearing are increasing. It is both a general trend and practical requirement for publishing administrations, publishers and academic institutions to use digital means to manage single papers.

The third area is platform management. Whether a journal or an individual paper, they all need to be published on one or several platforms. For administrative departments, supporting the construction and operation of publishing platforms might become the focus of future work. From the perspective of publishers, building a good platform or choosing reliable cooperation platforms is the only way for digital publishing. To explain further, carrying out digital economic activities of academic journals must also rely on the platforms. Considering academic institutions, platforms are their first choice, even the only choice under many circumstances to acquire academic resources. Therefore, platform management encompasses various aspects, including digital object identification (tracking what has been published and where it is stored) and contributor identification (identifying who did what).

The fourth aspect is evaluation management. Over the last decade or so (marked by DORA[20]), there have been unceasing calls for research evaluation reform. However, up to now, it seems that evaluating journals according to certain volumes and evaluating scholars (or papers) according to the journals in which they are published are still the prevalent practices. The malignant orientation of judging well-performed research by one certain or a few indicators has not yet been eradicated. The reliance on certain indicators to gauge a scholar's academic level is also a common occurrence. In the era of digital publishing, where single-paper publication and utilization have become popular, technological

[20] https://sfdora.org/.

innovations for accurate evaluation of certain papers or researchers is no longer a major problem. What needs to be innovated now is the concept and institutional arrangement.

4.3.4.3 Digitization Standards

In the era of the digital economy, the product form is digital, the tools are digital, the editing and publishing process is digital, and the business model is digital, which requires us to have corresponding digital standards.

In 2019, ISO released a newly revised international standard *Presentation and Identification of Periodicals*[21], which explicitly puts forward the concept of "born digital serial". This is a major step forward on the basis of electronic journals and digital serials, marking a high degree of recognition for digital-only journals that do not originate in print and do not require printing. To fully embrace and develop "born digital" journals, China may need to first revise a series of standards and norms.

The good news is that China began to officially implement the national standard "*Journal Article Tag Set*" (GB/T 40959—2021) on 1st June 2022. This standard will provide technical optimization and enhancement solutions for the production, publishing, and data exchanges of journals in China. It aims to improve publishing and dissemination efficiency, enhance the knowledge service capabilities of journals, realize data exchange between the up and downstream of the industry chain and among countries, and elevate the international impact of China's journals[28].

However, when it comes to standards related to digital editing and publishing of academic journals, there is still much groundwork to be done. For instance, China has yet to establish its own widely adopted national or industrial standards for DOI, contributor identity certification, version identification, and OA journals. Furthermore, our digital publishing terminology needs to be updated to accommodate industry developments.

On a global scale, academic journal publishing is an industry that ventured into the digital landscape relatively early. Looking ahead, the open science movement will bring new opportunities and markets for academic publishing. Given China's distinctive journal management system and operational framework, I firmly believe that our academic journals will play a greater and more influential role in the digital economy era.

4.3.5 Xing Shao: The Implementation Path of Integrated Development of STM Journal Industry in the Digital Economy Era[22]

To achieve the integrated development of the STM journal industry under the background of digital economy, the following measures can be taken. First, the adoption of integrated service platforms for STM journals can facilitate the transition to digital publishing. Second, providing good knowledge service is the core of the integrated development of the STM journal industry, which can be self-supporting, self-circulation, and self-development.

[21] https://www.iso.org/standard/67723.html.

[22] Xing Shao, Board chairman and President of Beijing Founder Electronic Co., Ltd.

Finally, building a sophisticated ecological system is the ideal state and goal for integrated development and to form the new development framework for STM journals.

4.3.5.1 Integrated Service Platforms are a Prerequisite for Industrial Integration and Development

4.3.5.1.1 Embracing Digital Transformation

To ensure successful industrial integration and development of STM journals, the first thing is to proactively embrace digital transformation. The traditional publishing process of academic journals is characterized by a large number of manual operations, resulting in a long production cycle and a single form of finished product, which constitutes an obvious bottleneck for the rapid dissemination of academic content. Therefore, STM journals must actively enhance their publishing service capabilities. Especially surrounding the informatization of traditional business procedures, STM journals should form technical ability for integrated development and establish an important pillar for high-quality development. Simultaneously, in the digital economy era, STM journals must establish their own data infrastructure to effectively carry out digital operations. Through the production process, it is essential to generate standardized structured data, empowering operational processes through data analysis. By accumulating a vast amount of data, STM journals can establish a robust data foundation for mining valuable insights, thus creating the fundamental conditions for industrial upgrading.

4.3.5.1.2 Ideas for Platform Utilization

STM journals have the option to either build their own platforms or make use of platforms developed by technology service providers. From their own positioning, technology service providers hope to promote the technological upgrading of the publishing industry through breakthrough technologies, bring greater value to users, and use technologies to empower new tools, refine workflow and business ecology construction, etc. Furthermore, they drive business innovation by embracing technological advancements, highlighting the role of academic big data and advanced algorithms in supporting actual business activities. These technologies provide robust data support for topic planning, leading expert screening, and high-quality manuscripts for publishing organizations.

The above-mentioned technical capabilities are reflected in integrated publishing and dissemination service platforms for STM journals. These platforms offer a variety of functions and services, including submission and review systems, XML digital publishing systems, clustered academic dissemination systems, academic big data application systems, and more. By utilizing these tools, academic journals can effectively transfer and upgrade into digital publishing, enabling publishers to establish advanced digital platforms that meet international standards.

4.3.5.2 Expertise Service is the Core of Industry Integration and Development

The challenge and major opportunity for STM journals is to effectively organize and utilize multi-source heterogeneous big data resources, along with academic literature resources, to provide professional knowledge service applications for industry users. The core user value

of knowledge service platforms is to help researchers distribute professional resources in the environment of academic information overload. To achieve this, there are three key strategies: aggregation, association, and recommendation.

4.3.5.2.1 Aggregation

When it comes to integrating and utilizing multiple types of data resources, it is essential to apply comprehensive approaches such as aggregation, association, and recommendation to establish a solid data foundation for applications. Aggregated contents include STM innovative information from journals, societies, institutions, scholars, and universities. It aims to merge academic publishing and information dissemination with scientific research activities, information dissemination, and achievement transformation in their respective disciplines and industries.

4.3.5.2.2 Associations

By constructing associations between resources of the same type and across different types, a comprehensive network of connections is established within various fields such as papers, journals, institutions, experts, scientific data, academic conferences, and frontier information. These associations are then showcased and presented on the service platforms.

4.3.5.2.3 Recommendations

Through established associations, cross-resource recommendations can be implemented. Moreover, personalized recommendations can be made for users based on their preferences, behavior, and interests. This involves creating user profiling based on articles they have published, their browsing history, and their interests. In turn, a model for resource contents is constructed, and the resource content model is matched with the user profile in both directions, his enables the recommendation of various types of resource contents that are likely to be of interest to the end-users.

As a technology provider, the Founder envisions the industry following the path of industrializing China's STM journals, *i.e.*, knowledge services within vertical fields. The industrialization here refers to the market means, so that STM journals as the main body, serving scientific research institutions and individuals, generating economic benefits, and achieving self-sustaining development. This sustainable approach is the key to progress.

4.3.5.3 A Perfect Ecosystem is the Ideal State of Industrial Integration Development

The optimal state of integrated development of the STM journal industry is to establish a complete academic ecosystem using platform thinking. This requires the promotion of media integration through product-oriented services and the creation of a professional, vertical, niche media platform with extensive resources. Ultimately, this will eventually form a sustainable operating model for knowledge services.

The academic ecosystem needs to open the communication chain to expand the academic value of traditional papers and form a closed loop for the dissemination of traditional papers and scientific and innovative information. It should run through the scientific research chain to promote the aggregation of disciplinary resources and data reuse, which can open up scientific research ideas and quickly enter the discipline frontiers. Furthermore,

it should activate the transformation chain to facilitate the sharing and application of scientific research results. By transforming these outcomes into technological applications, the sharing of scientific research results can be promoted.

In terms of operation mode, the internet model can be referred to with standard literature services adopting an OA or hybrid model to pool traffic. On the other hand, some more specialized content such as special issue content and subject service content can be monetized through charging fees. Through attraction and retention of traffic, and then realize traffic monetization. The economic benefits and business model can be realized even with low levels of traffic in specialized fields, which is a very promising industry pattern that I am optimistic about. As a technology provider, Founder integrates the best practices from other industries and collaborates with STM journals of some disciplines to make a good example, which can be further promoted to all disciplines.

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