Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 84 (2014) 70 – 79

Procedia Engineering

www.elsevier.com/locate/procedia

"2014ISSST", 2014 International Symposium on Safety Science and Technology

Bibliometric mapping of "International Symposium on Safety Science and Technology (1998-2012)"

LI Jie[a,b]*, GUO Xiaohong[a], SHEN Shifei[c], ALEKSANDAR Jovanovic[a, b]

[a]*School of Safety and Environmental Engineering, Capital University of Economics and Business, Beijing, 100070, China*
[b]*Steinbeis Advanced Risk Technologies, Stuttgart, 70174, Germany*
[c]*Institute of Public Safety Research,Tsinghua University, Beijing 100084, China*

Abstract

This paper aim to analyze the papers published in International Symposium on Safety Science and Technology (ISSST) in the period 1998-2012. Totally, 2781 ISSST papers were got from Web of Science, Bibliometrics indicators including annual publications, categories, geospatial distributions and topic analysis were used in this study. Results revealed that annual publications of ISSST could be divided in two stages, 1998-2004 as a period of increase in the number of publications and 2004-2012 as the period of decrease in the number of publications. The main categories of ISSST papers are in Engineering fields, that including Multidisciplinary Engineering, Industrial Engineering and Civil Engineering. Papers published in ISSST were originate from more than 30 countries/territories, while papers are mainly from China. In addition, these results also reflect in the institutional level. The analysis of the terms has revealed that all the topics of ISSST could be clustered into three groups, "safety and accident management", "fire safety" and "coal mine safety ". The time slice of the topic analysis also shown the similar results to the integer terms analysis.

Peer-review under responsibility of scientific committee of Beijing Institute of Technology

Keywords: Knowledge map; Bibliometrics; Scientometrics; Safety Science; Safemetrics;VOSviewer

1. Introduction

Conference in Safety Science and Technology is a good way for academic exchange and distribution of the new safety science progress among researchers and scholars. International Symposium on Safety Science and

* Corresponding author.
*E-mail address:*lijie_jerry@126.com.

Peer-review under responsibility of scientific committee of Beijing Institute of Technology
doi:10.1016/j.proeng.2014.10.411

Technology (ISSST, http://www.issst.com.cn/) is one of the world's most important conference in safety science and was held in China 8 times (Beijing 1998- 2000, Tai'an 2002, Shanghai 2004, Changsha 2006, Beijing 2008, Hangzhou2010 and Nanjing 2012). Thousands of papers have already been published at ISSST conferences in a various safety related topics. All papers published at ISSST were indexed by the world's famous conference database - CPCI-S (the former name of CPCI-S was ISTP, 1998-2012). The main scope of the conference was on seven basic areas in the safety science: (1) Theories and methods of safety science; (2) Safety assessment and risk analysis; (3) Prevention of fire, explosion, dust and ventilation; (4) Safety management, education and training; (5) Public safety; (6) Methods for reliability and probabilistic and (7) non-probabilistic safety assessment. These areas are mainly covered within the domain of safety science.

In this study, bibliometrics mapping method was used to analyze the data set. Bibliometrics is the scientific field that concerns with a quantitative analysis of books, articles, and other types of written communication [1]. Bibliometrics-mapping is a new and effective way to use visualization methods, showing meaningful results of raw (or normalized) scientific data. It can be a good technique to assist experts to improve their knowledge in a certain domain, and has been already applied to analysis of the safety related topics [2]. In this study, the bibliometrics methods were first applied to give the numeral view of the ISSST papers during 1998-2012. Bibliometrics indicators including annual publications trends, papers categories in Web of Science, Geographical distributions and various ISSST topics have been analyzed in this study.

2. Data and methods

The bibliographic data set of ISSST was obtained from Web of Science Core Collection, Conference Proceedings Citation Index- Science (CPCI-S), and starting from1990 to present. The data retrieving method was set as "CONFERENCE: (International Symposium on Safety Science and Technology); Timespan=1990-2014; Indexes=CPCI-S". Totally 2,781 results have been collected from WoS (the data have been already shared online: http://blog.sciencenet.cn/blog-554179-778376.html). In this study, the VOS (visualization of similarities) map technologies and the free software (free download http://vosviewer.com/) VOSviewer were applied to visualize the ISSST map. There are two (label view, density view) out of four views (label view, density view, cluster density view and scattered view) of VOSviewer which were applied in this research. One map technology was called for giving the position of each terms in the two-dimension map. The other view is density view, used to give an overview of the general structure of the map and shown at the most important research area. For detailed methods and descriptions please refer here [3]. The basic analysis steps of this study are shown in Fig.1.

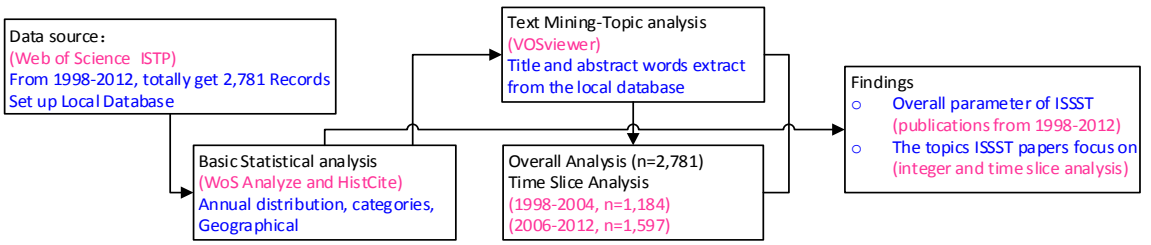


Fig. 1. The process of bibliometrics mapping in ISSST research.

3. Results

3.1. Overview of ISSSI publications

- Publication distribution of ISSST

The publication output of ISSST is displayed in Fig.2 and Table 1. The annual publications of ISSST papers revealed that ISSST had published 549 papers in 2004, which was the peak of publication output. Based on the publications peak, the publication age can be divided into two parts. From 1998-2004, the publications had an

enormous increase, while the number of ISSST publications has been gradually decreasing after 2004. These phenomena may reflect the research activities in the field of safety in China. The cumulative number of papers consistently increased, and can be described with the linear model y = 208.08x -415743 and R^2 = 0.9835, reflecting the annual growth trend of cumulative papers.

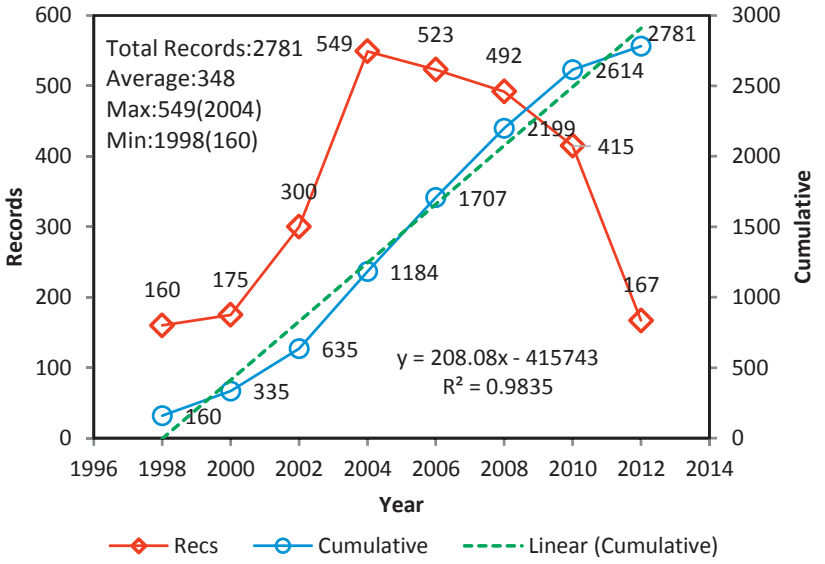


Fig.2. Publication outputs of ISSST indexed by ISTP.

Table 1. Detail information of ISSST Publications.

#	Publication Name	Year	Place	Pages	Recs	APPY	TLCS	TGCS
8th	2012 International Symposium on Safety Science and Technology	2012	Nanjing	1038	167	6	0	10
7th	Progress in Safety Science and Technology, Vol VIII, PTS A & B	2010	Hangzhou	2623	415	6	3	16
6th	Progress in Safety Science and Technology, Vol VII, PTS A & B	2008	Beijing	2560	492	5	6	43
5th	Progress in Safety Science and Technology, Vol VI, PTS A & B	2006	Changsha	2570	523	5	11	79
4th	Progress in Safety Science and Technology, VolIV, PTS A & B	2004	Shanghai	3085	549	6	25	216
3rd	Progress in Safety Science and Technology, Vol III, PTS A & B	2002	Tai' an	1570	300	5	16	60
2nd	Progress in Safety Science and Technology, Vol II, PTS A & B	2000	Beijing	1044	175	6	8	18
1st	Progress in Safety Science and Technology	1998	Beijing	1028	160	6	10	28

Note: The information of pages of the books is obtained fromhttp://www.issst.com.cn/proceedings.htm, Recs=Full. Records of ISSST publications are obtained from Web of Science; APPY= Average number of pages of the articles; TLCS represents local citations scores, meaning the number of times cited by other papers in the local database (in this research, the local database included 2,781 records); TGCS is global citations score, meaning the number of times the publications were cited by other papers in Web of Science.

- **Research Domains of ISSST papers**

The Web of Science categories of ISSST papers are displayed in Fig.3. The main research area of ISSST papers was in Multidisciplinary Engineering (1707, 61.381%), followed by Industrial Engineering (1351, 48.58%), Civil Engineering (907, 32.614%), Public Environmental Occupational Health (792, 28.479%), Multidisciplinary Sciences (335, 12.046%) and Operations Research Management Science (167, 6.005%). The results of ISSST research domains have demonstrated that ISSST was mainly active in engineering and multidisciplinary areas.

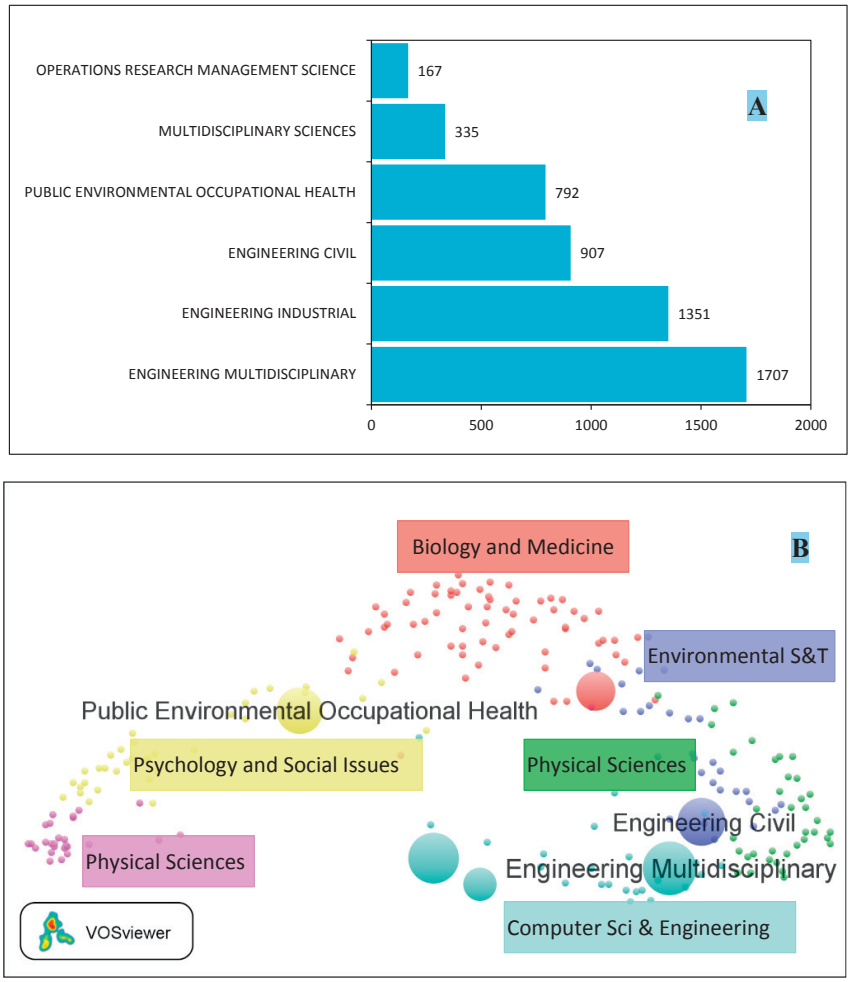


Fig.3. Distribution of the research Domains of ISSST papers

Note: A is basic statistcal results of ISSST domains, B is the position of ISSST domains in the whole map of science[4, 5] (in this study, we have useed the 6-Factor layer map, including: (1) Psychology and Social Issues-yellow; (2) Bio logy and Medicine-red; (3) Social Sciences-purple; (4) Computer Sci & Engineering-cyan; (5) Physical Sciences- green; (6) Environmental S&T-blue.

- **Geographical distribution of ISSST papers**

The papers published at ISSST were published by authors from 30 different countries/territories during 1998-2012. In the list of countries/territories, which have published more than one paper at ISSST (See Table 2), China is ranked as number one having 2,367 papers published or a share of 85.1%. The conference held in China increased the enthusiasm of Chinese scientists to take part in the conference and share the papers in ISSST. Other productive countries/territories are South Korea (28, 1.0%), Taiwan (27, 1.0%), Canada (17, 0.6%) and Japan (14, 0.5%). The analysis of the institutions has shown that all the institutions which have published more than 40 papers were from China. Beijing Cent S Univ (155), China Univ Min &Technol (146) and InstTechnol (134) were top 3 institutions that published more than 100 papers at ISSST during 1998-2012. Other instituions like Chinese Peoples Armed Police Force Acad, Henan Polytech Univ, Univ Sci &Technol China and Beijing Jiaotong Univ (etc…) also performed well in their publications (see Fig.4).

Table 2. Number of publication output in different countries/territories (Records more than one have been listed).

Rank	Country	Recs	Percent (%)	TLCS	TGCS	Rank	Country	Recs	Percent (%)	TLCS	TGCS
1	Peoples R China	2367	85.1	67	423	12	Netherlands	7	0.3	1	2
2	South Korea	28	1.0	0	8	13	Russia	7	0.3	0	0
3	Taiwan	27	1.0	0	4	14	Belgium	6	0.2	0	2
4	Canada	17	0.6	0	5	15	Germany	5	0.2	0	0
5	Japan	14	0.5	0	0	16	UK	5	0.2	0	0
6	USA	12	0.4	0	1	17	Australia	3	0.1	0	0
7	France	10	0.4	0	2	18	Brazil	2	0.1	0	0
8	Poland	10	0.4	2	4	19	Iran	2	0.1	0	0
9	India	9	0.3	0	0	20	Saudi Arabia	2	0.1	0	0
10	Hungary	8	0.3	4	2	21	Spain	2	0.1	0	0
11	Italy	8	0.3	0	2	22	Switzerland	2	0.1	0	0

Note: The online map can be explored at
https://www.google.com/fusiontables/DataSource?docid=1o9_i3jikcZcVtxZcUcDLbxUrXBv9F7APPZDpDydM

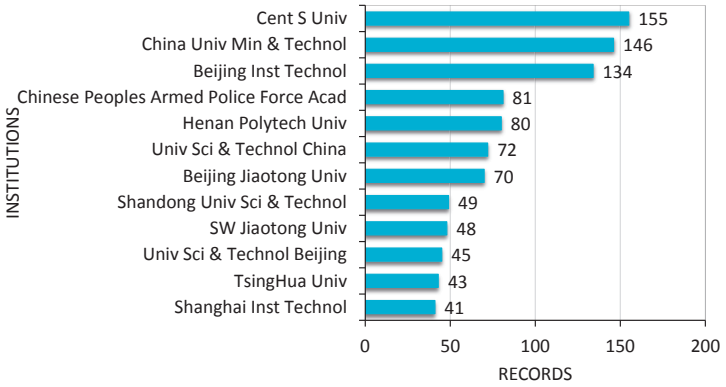


Fig. 4. Distribution of institutions of ISSST papers.

3.2. Topic analysis of ISSST

Publications of ISSST terms which were used in the title and abstract can refelct the main topics of scientific research. The knowledge mapping sofeware VOSviewer, which uses processing techniques yields a list of all noun phrases from title and abstract. In this part, two aspect of the topic map of ISSST were mapped. First, the overall terms acquired from 2,781 pubilications are displayed in Fig.5 and Fig.6. In these two maps, minimum 10 terms were selected as the minimal number of occurrence and 38,697 terms have been extracted from the title and abstract area, 865 terms had met the threshold and have being mapped. For each of the 865 terms, a relevance score was calculated, and on the base of this score, the most relevant terms were selected. At last, a totall of 519 terms were selected and mapped. In order to show the clear cluster, the value of 0.8 was selected as clustering resolution.

The terms were in the next step divided in three clusters (terms with the same colour were in the same cluster). Cluster 1 (red) was named as “safety and accident management” (including in total 236 terms), where was paid more attention to use of management methods for accident control and analysis. Cluster 2 (green) was named as “Fire safety research” (including in total 144 terms). In this cluster, terms are mostly related to the fire research. “Coal mine safety research” is the name of Cluster 3 (Blue, including in total 139 terms). Term “numerical simulation” reflects the basic method that was used in this cluster. For more detailed information of the terms please refer to Table 3.

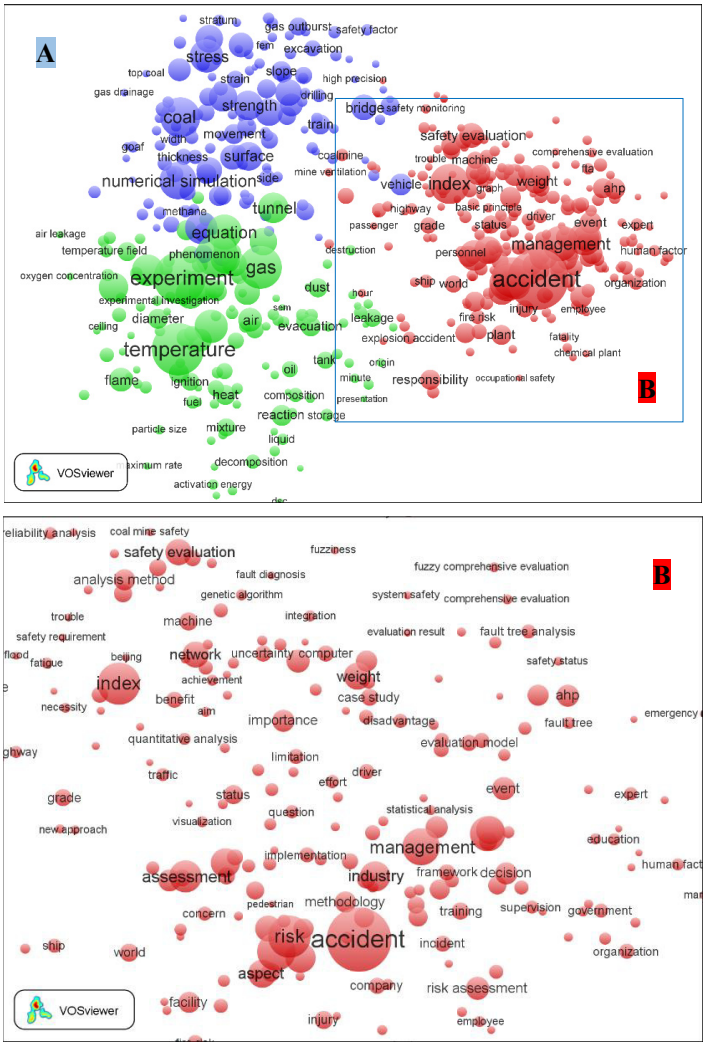


Fig. 5. Label view of ISSST terms (in the label view, terms are displayed by label and marked with circle. The higher the occurrence of the terms, the larger are their labels and circles. Color of the circle was used to distinguish between different clusters, which are based on the VOS technique. In order to avoid overlapping labels only a sub-set of all labels was displayed). Figure 5B is an example of zooming of Cluster 1 (Red).

Since the published papers were mainly from China, it reflect that safety science and technology research in China are mainly in the area of fire and coal research (please refer to Cluster 2 and Cluster 3). The highly productive institutions, including Cent S Univ, China Univ Min & Technol and Beijing Inst Technol all have a special departments in the area of fire and coal research. Even though the papers from 7 areas have been presented at ISSST, the results can be mainly clustered into three areas.

While performing in depth analysis, the ISSST data were divided in two time slices, from 1998 to 2004 and from 2006 to 2012. (Fig7). VOSviewer density map was used to get an overview of the general structure of the ISSST keywords map and show the most important area in ISSST. During the year “1998, 2000, 2002 and 2004”, the resarch was mailny focused on “accidents” and “experments”. If we make a comparison between years “2006, 2008, 2010 and 2012”, we will see that no siginificant changes occurred between these two periods. They have same high frequence of the terms “accident”, “experiment”, “temperature” and “test”.

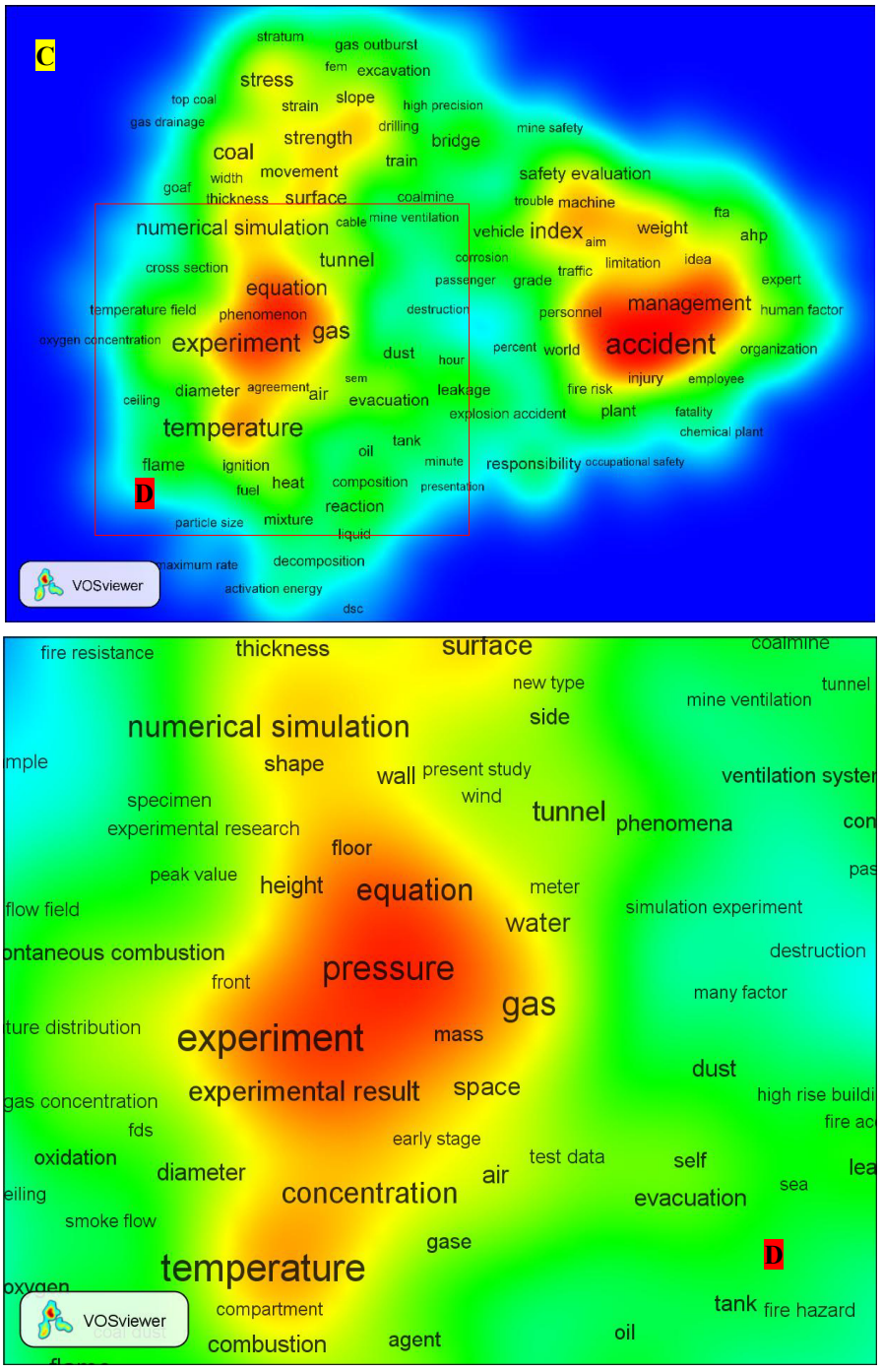


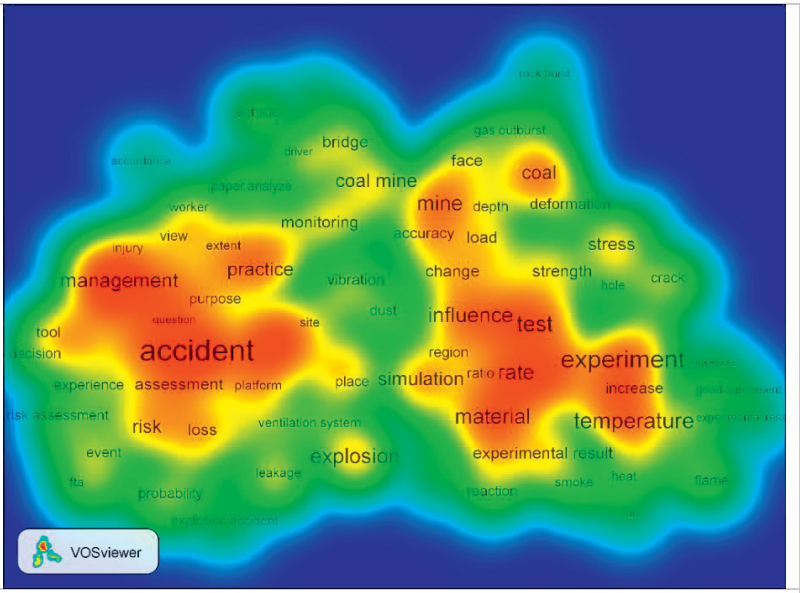
Fig. 6. Density view of the ISSST terms (the color in the density view was ranging from red to blue. The color of a point depends on the numbers of terms in the neighborhood of the point and on the importance of the neighboring terms. Density visualization of the ISSST terms clustered together in two groups showed that the left side was mainly reflecting the fire safety topics and the right side the accident and management topics.

Table 3. Distribution of top 35 terms in ISSST.

NO.	Cluster 1:Safety and Accident Management		Cluster 2: Fire Safety Research		Cluster 3: Coal Mine Safety Research	
	Terms	Frequencies	Terms	Frequencies	Terms	Frequencies
1	accident	353	temperature	272	coal	173
2	index	173	experiment	271	numerical simulation	153
3	risk	172	pressure	199	stress	127
4	person	145	gas	196	increase	124
5	management	144	equation	142	strength	107
6	safety management	129	concentration	132	surface	102
7	assessment	109	velocity	117	face	100
8	industry	100	tunnel	111	rock	97
9	cause	98	experimental study	108	load	96
10	probability	93	experimental result	106	mining	90
11	aspect	90	flow	105	zone	86
12	enterprise	88	water	93	bridge	83
13	weight	86	space	83	deformation	81
14	network	81	simulation result	77	formula	78
15	tool	81	flame	74	coal seam	68
16	safety evaluation	80	air	73	depth	68
17	event	66	size	71	vehicle	64
18	risk assessment	66	smoke	71	wave	61
19	safety assessment	63	length	68	train	57
20	experience	62	reaction	60	intensity	56
21	importance	62	diameter	57	slope	56
22	AHP	60	evacuation	56	wall	55
23	decision	60	combustion	55	movement	54
24	strategy	59	heat	54	curf	53
25	methodology	57	dust	53	railway	53
26	evaluation method	56	ventilation	53	loading	50
27	facility	56	decrease	52	gas outburst	49
28	index system	56	propagation	52	vibration	49
29	plant	56	spontaneous combustion	52	phenomena	48
30	responsibility	55	variation	51	phenomenon	48
31	consequence	54	experimental data	48	crack	47
32	countermeasure	53	gas explosion	47	test result	47
33	regulation	50	ignition	47	mechanic	45
34	risk analysis	50	leakage	47	strain	43
35	health	48	mixture	47	Beam/soil	42

Note: The whole table of 519 terms was shared on:
https://docs.google.com/spreadsheets/d/1uZ6e3oG2W1SZLyxKVoz0HNONbxYa4UPMePrMgaz3Pnk/edit?usp=sharing

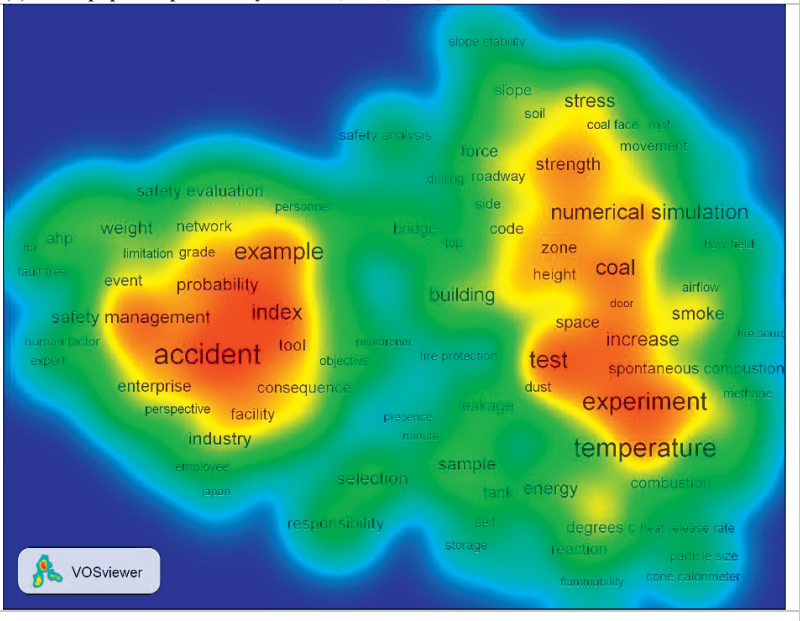
From the terms analysis we can conclude that “fire safety research”and “coal mine safety research” were the mainly research areas in ISSST, and also reflected strong Chinese interest in these areas. Accidents and mangement related safety topic can be percieved as mutidisplinary aspect of the safety research, and could include nearly all the safety resarch topics.



(a)ISSST papers topic in the year 1998,2000, 2002,2004	High frequency terms in 1998~2004

Top 20 key terms+Frequencies

1.	accident	147
2.	experiment	97
3.	temperature	82
4.	test	77
5.	explosion	76
6.	mine	75
7.	rate	73
8.	influence	72
9.	material	70
10.	reliability	66
11.	management	63
12.	coal	59
13.	gas	59
14.	simulation	57
15.	coal mine	56
16.	risk	56
17.	index	55
18.	safety management	54
19.	industry	53
20.	practice	53



(b)ISSST papers topic in the year 2006,2008, 2010,2012	High frequency terms in 2006~2012

Top 20 key terms+ Frequencies

1.	accident	248
2.	temperature	198
3.	experiment	181
4.	example	154
5.	test	150
6.	pressure	149
7.	gas	137
8.	evaluation	134
9.	risk	125
10.	concentration	123
11.	coal	119
12.	index	118
13.	numerical simulation	117
14.	information	99
15.	management	99
16.	equation	97
17.	person	95
18.	increase	92
19.	approach	90
20.	stability	88

Fig. 7. Hot topic in ISSST from 1998-2012 (the minimum occurrences of these terms in the map is equal or more than 10 times).

4. Conclusions

The bibliometrics mapping was used to analyze the eight times of ISSST publications during 1998-2012. Four indicator of ISSST papers were analyzed, including temporal distribution of publications, research domains of ISSST papers, geographical distribution and topic analysis. According to the study, papers published in ISSST could be divided in two stages and the year 2004 represents the peak of the publications (with 549 papers). On the other side, the cumulative number of ISSST papers was increasing linearly. The Web of Science categories of ISSST

papers were mainly related to engineering and multidisciplinary, reflecting the main domains of safety science. Geographical analysis has showed that Chinese authors have published 2,367(85.1%) papers, ranking the first place among other 30 countries/territories. Additionally, South Korea, Taiwan, Canada, Japan and USA had relative good performance, reflecting their take actively part in ISSST. The geographical results showed that Chinese institutions play an important role in ISSST (Cent S Univ, China Univ Min &Techno etc.). Topic analysis revealed that "safety and accident management" (management), "fire safety research" (Engineering) and "coal mine safety" (Engineering) were three main research areas, which ISSST is focused on. Compared with overall topic analysis, similar results were also shown for topic analysis within time slice.

In the dataset of the ISSST papers, a large amount of the references and authors' names were written in different types, and these situations made us more difficult to get exact results in this data set. This is the reason why we do not give the results about these parameters in the study. In order to keep the high quality of ISSST papers, the high require of the format of ISSST papers should be improved. More information about safety related bibliometrics introduction, are being made available at http://www.safemetrics.risk-technologies.com/.

References

[1] R. Heersmink, J. van den Hoven, N. J. van Eck, and J. van den Berg, "Bibliometric mapping of computer and information ethics," Ethics and information technology, vol. 13, pp. 241-249, 2011.

[2] J. Li, X. Guo, K. Jiang, and P. Lu, "Preliminary Study of Knowledge Map of Safety Science - - Base on Data of Safety Science," China Safety Science Journal（CSSJ）, vol. 23, pp. 152-158, 2013.

[3] N. J. Van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," Scientometrics, vol. 84, pp. 523-538, 2010.

[4] L. Leydesdorff, S. Carley, and I. Rafols, "Global maps of science based on the new Web-of-Science categories," Scientometrics, vol. 94, pp. 589-593, 2013.

[5] K. Riopelle, L. Leydesdorff, and L. Jie. (2014). How to Create an Overlay Map of Science Using the Web of Science. Available: http://www.leydesdorff.net/overlaytoolkit/manual.riopelle.pdf