Review of Environmental Safety Research Based on Systematic Mapping Study: Taking CNKI Database as an Example

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Abstract. This paper applies the Systematic Mapping Study (SMS) to the review of environmental safety research in China. Different from the traditional systematic literature review, this study focuses on the classification and analysis of related literatures to form a number of quantitative, systematic visualization images to identify the current status and gaps in the research field. The paper follows the SMS analysis steps, takes the literature related to environmental safety research in recent 3 years from CNKI database as the analysis sample. SMS method is used to systematically analyze the publication trends, research types and research contributions, which offers a visual summary map of the field. The research results show that the SMS method can reflect the status quo of environmental safety research and identify research gaps efficiently and accurately, and can put forward targeted opinions accordingly.

1. Introduction

The content of environmental safety research is scattered and complicated. It is difficult to analyze all the documents using the traditional systematic literature review method. However, there will be a lack of accuracy in content analysis if simply relying on the scientific knowledge map. This paper combines the research of two scales and uses the SMS method to classify and summarize.

SMS is a special systematic literature review method that is widely used in software engineering research and is applicable to areas that lack high-quality basic research[1]. The traditional systematic literature review focuses on a specific problem, and summarizes all relevant literature to analyze the research status[2]. But the SMS method focuses on the definition of general problems of paper, as well as classifying and analysing the related literature to form a number of quantitative and systematic visualization images to identify the current status and gaps in the research field[2].

2. Research steps

According to Petersen’s research[3-4], the SMS method usually has five steps as shown in figure 1, including Definition of research questions, Conduct search, Screening for papers, Keywording, Data extraction and Mapping.
2.1 Definition of research questions

Based on the research of Akoka, this paper defines the research questions shown in Table 1 from the perspectives of time, method and contribution[4]. The definitions are more general, but they can reflect the status of research in the field from different angles.

| Number | Questions                                                                 |
|--------|---------------------------------------------------------------------------|
| 1      | What are the trends of the publication of environmental safety research papers? |
| 2      | What are the main types of research in the field of environmental safety? |
| 3      | What are the main contributions of environmental safety research?          |

2.2 Conduct search for papers

In this study, the CNKI database was used as the analysis object. In order to ensure the quality of the literature, this paper selected relevant core journal articles as analysis samples. This article uses "environmental safety" as the keyword for subject search. The search time is from 2016 to 2018. The first search obtained 296 papers.

2.3 Screening for relevant papers

Based on the actual research and reference to other scholars' research[4-5], this article established the inclusion & exclusion criteria shown in Table 2. The reason for limiting the sample to core journal papers is that selecting core journal papers that represent the level of discipline development is the most effective way. The titles, abstracts, and keywords of the 196 retrieved papers were manually screened to exclude papers not related to environmental safety research. The final sample number was 81.

| Inclusion                                      | Exclusion                  |
|-----------------------------------------------|----------------------------|
| 1 Core journal papers in CNKI database        | Non Chinese papers         |
| 2 Published in 2016-2018                      | Non Journal Papers         |
| 3 Topic related to environmental safety        | Incomplete structure       |

2.4 Keywording

Year is the basic information dimension, which aims to analyze the paper output trend of the research. In terms of research type and contribution dimension, it is the main method to determine the classification scheme by using keywords on the basis of previous research, which can not only save the classification time, but also ensure that the scheme includes the existing research[3]. Scholars often adjust the research type based on Wieringa's research[6], and their classification schemes are relatively similar[7-9]. The classifications of research contributions also refer to previous research results[10], but there are great differences due to different research contents[3,4,7,9].
According to the extracted domain keywords, this paper classifies and numbers the samples, and through browsing the full text of the samples to constantly update the scheme. Finally, the research types are determined as 5 categories: evaluation research, analysis research, solution proposals, opinion papers, development & application research, while the research contributions are determined as 6 categories: lessons learned, framework, model, advice, method, and system & platform.

2.5 Data extraction and mapping
According to the classification scheme determined, the research sample is classified and coded, and appropriate charts are selected to draw to answer the research questions.

3. Results

3.1 Answer to the first question
Figure 2 reflects the trend of paper output in the field of environmental safety. It can be seen that the number of related papers in the past three years is around 20-30, which fluctuates slightly. If we increase the time interval, the overall trend will be more obvious.

![Figure 2. Trend of published papers](image)

3.2 Answer to the second question
Figure 3 reflects the main types of research in the field of environmental safety in the past 3 years. It can be found that with the exception of development & application research, the type of research in this field is relatively balanced. Evaluation research accounts for the largest proportion (30.9%), and solution proposals, analysis research, and opinion papers types are almost equal, each accounting for about 22.2% of the total. Evaluation research mainly includes safety evaluation and field review. Solution proposals aims to propose new methods, technologies, and model systems. Opinion papers often contain keywords such as ‘inquiry’, ‘idea’, ‘suggestion’, or ‘strategy’. Analysis research papers mainly use existing data to model and analyze.

3.3 Answer to the third question
As can be seen from figure 3, the distribution of each contribution type is unbalanced. Lessons learned is the main contribution of domestic environmental safety research in recent years, with 31 papers. They are more common in evaluation research, which mainly includes field reviews and data analysis conclusions. Advice is the second largest research contribution, focusing on analyzing the existing problems in existing research and making corresponding suggestions. Method followed closely, mainly in the papers of specific methods. The number of papers for the remaining three types of contributions is less than 10.
4. Discussion

In order to more clearly show the research status and gaps in the field of environmental safety, this paper combines the three aspects of year, research types, and research contributions to draw a bubble chart as shown in Figure 5. Compared with the frequency table, the bubble chart can consider different research aspects at the same time, the bubble size can more intuitively reflect the number of papers, and it is easier to find research gaps.

This paper applies the SMS method to the analysis of environmental safety research, classifies and maps the related literature with a problem-oriented systematic thinking, and aims to show the current status of research and find research gaps. However, due to the limited space, this article only analyses the relevant researches in the past 3 years. In future research, we can use new technical methods such as NLP and Machine Learning to continuously improve our analysis capabilities and knowledge discovery capabilities, so that we could present a more holistic view of the current state of environmental safety research.

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