Bibliometric and Visualized Analysis of Scientific Publications on Geotechnics Fields

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ABSTRACTS

The advancement of civil engineering plays a major role in determining the nation’s development. Generally, geotechnical engineering has a great influence as there is a building on the ground. The facts show that there are still many geotechnical problems that arise during the development process. One of the supporting factors in dealing with these problems is the development of research in the geotechnical sector in various fields. This research aims to determine the development of research related to Geotechnical Engineering through a bibliometric distribution map using the VOSviewer application. Data collection is gathered from the dimension site. The keyword used in this study is "geotechnical engineering" with the publication year of the 2017-2020 articles. This search was conducted on 23 October 2020 which resulted in 79,185 articles. The results show that the most productive writer in geotechnical research is Ronald Kerry Rowe. Moreover, China is the largest country in the field of geotechnical research so that many other countries have established cooperative relations with China. The journal that publishes the most articles on geotechnical engineering is the International Journal of Rock Mechanics and Mining Science. As for keyword analysis, it produces bibliometric maps including network visualizations, overlay visualizations, and density visualizations. Four keywords often appear, namely "Displacement", "Strength", "Stress", and "Earthquake". Through the bibliometric approach, researchers can identify keywords on each topic.
or research that has been done before, it is, therefore, valuable in determining the novelty of the research that will be conducted in the future.
1. INTRODUCTION

The development of civil engineering to date has had a major influence in the field of infrastructure development, particularly in the field of geotechnical engineering. Geotechnical Engineering is concerned with the application of science and technology to the implementation of civil engineering regarding several aspects of the earth, such as the nature of natural materials on the earth's surface including soil and rock (Holtz et al., 2010).

Geotechnical science has a major role in dealing with several geotechnical problems in the field, such as bearing failure, differential settlement, and ground have. soil instability, liquefaction, landslide, and seepage. Various attempts have been made to address these problems, including through research. Therefore, it is necessary to have a comprehensive study so that it can assist researchers in finding various alternative solutions to geotechnical problems.

This study aims to determine the development of research related to Geotechnical Engineering through bibliometric distribution maps and research publications on the Dimension database using the Vosviewer application. Bibliometrics is an effective way of providing datasets that can be used by policy makers, researchers, and other stakeholders (Nandiyanto et al., 2020). The distribution of maps in this study consisted of the type of publication, the topics studied, and the researchers' country of origin.

Studies have been conducted to ascertain the effect on RBC performance of factors such as recirculation, disk rotational speed, temperature, hydraulic conditions, presence of organic particulate matter, use of supplemental air and scale-up (Cortez et al., 2008; Hassard et al., 2015). Disk rotational speed affects oxygen transfer to the biofilm for substrate utilization while loading conditions determine the overall treatment capacity of the bioreactor.

2. MATERIALS AND METHODS

Bibliometric analysis, also known as scientometrics, is a development of the meta-analysis research method (Nandiyanto et al., 2010). In general, the process of bibliometric research is shown in Figure 1.

![Figure 1. Bibliometric analysis process flow chart](http://dx.doi.org/10.xxxxx/AJSEE.v1i1)
In this study, data collection was carried out from the dimension site which provides a dataset of scientific articles that have been published in international journals under open source and can be downloaded in the form of CSV files. Then the dataset is opened using the Vosviewer software, the Vosviewer software will present the dataset into a mapping visualization for analysis. The keyword we used in this study was "geotechnical engineering" with the publication year of the 2017-2020 article, this search was conducted on 23 October 2020 which resulted in 79,185 samples.

3. RESULTS AND DISCUSSION

The dataset in this study uses a span of the year the articles were published from 2017 to 2020. The search results through the dimension database show that research on geotechnical engineering has developed since 2011, totaling 9780 articles. The tracing is shown in Figure 2.

![Figure 2. Number of geotechnical engineering research publications from 2011 to 2020](image)

3.1. Author analysis

The most relevant authors based on the number of citations and publications are shown in Table 1. Authors from various universities in the world are working hard to research the geotechnical sub-fields of each researcher. Table 1 also shows the relationship between the most productive authors in terms of number of articles and the most cited authors. In this study, we took the top 10 rankings, authors who published on geotechnical engineering.

Table 1. Names of the top 10 ranking authors who publish geotechnicalengineeing based on the number of citations (a) and the number of articles (b).

| Rank (a) | Authors Name         | Citations | Rank (b) | Authors Name          | Published Article |
|---------|----------------------|-----------|----------|-----------------------|-------------------|
| 1       | Ronald Kerry Rowe    | 8877      | 1        | Ronald Kerry Rowe     | 381               |
| 2       | Scott William Sioan  | 8655      | 2        | Buddhima N Indraratna | 378               |
| 3       | Mark Felton Randolph | 8214      | 3        | Charles Wang Wai Ng   | 360               |
3.2. Country Analysis

Based on the dimension database, 89 countries are researching the field of geotechnical engineering. This is due to the large number of institutions that include the names of their members and countries so that the dimension can read the data. Although 89 countries research the field of geotechnical engineering, we limit it to the top 10 countries that publish the most articles and based on cooperation with other countries in writing, it can be seen in Table 2.

Table 2. Ranking of the 10 countries that publish the most research (a), and cooperation with other countries (b)

| Rank (a) | Countries          | Published Article | Rank (b) | Countries          | Total Link Strength |
|---------|---------------------|-------------------|----------|---------------------|---------------------|
| 1       | China               | 916               | 1        | China               | 336                 |
| 2       | United States       | 286               | 2        | United States       | 227                 |
| 3       | India               | 199               | 3        | United Kingdom      | 127                 |
| 4       | Iran                | 153               | 4        | Australia           | 123                 |
| 5       | United Kingdom      | 137               | 5        | Iran                | 83                  |
| 6       | Australia           | 135               | 6        | Canada              | 72                  |
| 7       | Canada              | 118               | 7        | Germany             | 71                  |
| 8       | Italy               | 102               | 8        | India               | 61                  |
| 9       | Germany             | 79                | 9        | Italy               | 58                  |
The bibliometric analysis based on the country analysis in the field of geotechnical engineering is shown in **Figure 3**. Based on **Figure 3**, China is the largest country in conducting geotechnical research so that many other countries have established cooperative relationships with China. For more than half a century, the Chinese engineering investigation industry has continued to develop and has completed many investigative projects independently. Since the 1970s China’s industry has undergone a transition to a “Geotechnical Engineering Mechanism” and made great strides in geotechnical development. China is a vast country and many factors hinder the technical progress of the industry, therefore the concept of "people-oriented" and "scientific development" strategies provides many new opportunities for geotechnical engineers to develop geotechnical engineering (Zai-ming Zhang et al., 2011).

**Figure 3.** Visualization based on countries researching the field of geotechnical engineering

### 3.3 Journal Analysis

Based on the number of article publications and the citation of the dimension database analysis results, it shows that the journal that publishes the most geotechnical engineering articles is the International Journal of Rock Mechanics and Mining Science with a publication number of 14094 articles. **Table 3** shows the top 10 journals that publish the most articles on geotechnical engineering. From the results of the top 10 journals dominantly discuss Rock mechanics, Geoenvironmental, Soil Dynamics and Earthquake, Computers and Geotechnics, and Foundations.

**Table 3.** Top 10 journals ranking that publish the most research (a) and the number of citations (b)

| Rank (a) | Journals                                                  | Published Articles | Rank (b) | Journals                | Citations |
|----------|-----------------------------------------------------------|--------------------|----------|-------------------------|-----------|
| 1        | International Journal of Rock Mechanics and Mining Science | 14094              | 1        | Canadian Geotechnical Journal | 123166    |
3.4. Keyword Analysis

Keywords are very useful in interpreting the scope of the research scope and the main themes of each study (Mubaroq et al., 2020). The minimum number of conjunctions in the use of Vosviewer is 10 words. After being analyzed using Vosviewer, there are 4 clusters (red, green, blue, and yellow), this shows the relationship between one topic and another (Hamidah et al., 2020). Vosviewer provides three different mapping visualizations namely network visualization, overlay visualization, and density visualization (Van Eck & Waltman, 2020). Keywords are labeled with a colored circle. The size of the circles shows a positive relationship between the occurrence of keywords in the title and the abstract. Therefore, the size of letters and circles is determined by the frequency with which they appear. The more often a keyword appears, the larger the font and circle size will be (Hamidah et al., 2020). The results of the VOSviewer keyword analysis are shown in Figure 4-6.

Figure 4 shows the groups of each topic studied. It can be seen that four keywords often appear, namely "Displacement", "Strength", "Stress", and "Earthquake". which means that the topic is the most researched by researchers.

Figure 5 shows the development from year to year related to geotechnical engineering. It can be seen that 2017 to 2018 was the year when many researchers used geotechnical engineering
keywords in their research, marked in purple towards blue. Meanwhile, from 2019 to 2020 research in the geotechnical sector has decreased.

**Figure 6** shows the depth of the study. A large yellow color indicates a lot of research has been done or is undergoing improvement on the topic. Meanwhile, research with a small amount of color fades towards the blue color.

**Figure 5-6** shows that the keywords that often appear are displacement, sand, stress, strength, and earthquake. Based on these data, we can find the novelty of geotechnical engineering research. For example, little research has been done on the seismic response in organic soils. In the end, researchers can contribute to overcoming the problem of dynamic response to organic soil using various theoretical and technological approaches. Furthermore, to see the availability of data or information in each topic area, a search can be made using more specific keywords.

![Figure 4](image1.png)  
**Figure 4.** Visualization of keywords (keyword co-occurrence) with network visualizations using Vosviewer.

![Figure 5](image2.png)  
**Figure 5.** Visualization of keywords (keyword co-occurrence) with network visualizations using Vosviewer.
4. CONCLUSION

Infrastructure development in the world continues to increase. Therefore geotechnical engineering is needed to overcome various problems related to soil. Based on the results and discussion above, it can be concluded that geotechnical engineering research continues to increase from 2017 to 2020 reaching 24917 articles. Ronald Kerry Rowe is Queens' University's most prolific writer. China is the largest contributor to geotechnical research. The most international publications on geotechnics are published by the International Journal of Rock Mechanics and Mining Science. Based on the results of keyword analysis, there are four keywords that appear most often, namely "Displacement", "Strength", "Stress", and "Earthquake". Through the bibliometric approach, we can identify keywords on each topic or research that has been done before, so it is very useful in determining the novelty of research that will be carried out in the future.

5. ACKNOWLEDGEMENT

Isah Bela Mulyawati and Doni Fajar Ramadhan would like to thank to UKM LEPPIM UPI for giving the training in writing scientific articles. The authors thank to the Universitas Pendidikan Indonesia journal development team who have facilitated the publication of this article.

6. AUTHORS’ NOTE

The author(s) declare(s) that there is no conflict of interest regarding the publication of this article. Authors confirmed that the data and the paper are free of plagiarism.

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