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BIBLIOMETRIC ANALYSIS OF HIGH-RISE BUILDING PLANNING WITH CPM AND PERT METHODS USING VOSVIEWER

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KEYWORDS
Critical Path Method; Program Evaluation and Review Technique; Planning; Management Construction; High-rise Building

ABSTRACT

This research shows the developments that have occurred in high-rise building building planning worldwide by presenting bibliometric analysis data. The database that appears from Publish or Perish can be converted into mapping with the help of VosViewer software. In this analysis, it can be seen how relevant this research is globally. The results of data processing show that the majority of research comes from journal articles, with a total of 774 studies (85.33%), and the peak of research occurred in 2022 with 114 studies. Elsevier BV is a publisher that has a high interest in the development of high-rise building planning, with a total of 432 studies (65.90%). Evaluation is the most dense visualization, followed by buildings and high-rise buildings. This shows that high-level building planning using the CPM and PERT methods can still develop.

INTRODUCTION

Rapid global development in densely populated cities makes limited land a big challenge. High-rise buildings are an effective solution by utilizing space vertically (Akristiniy & Boriskina, 2018). This capability allows more activity and increases the population in limited areas, optimizing the use of increasingly scarce land amid increasing urbanization (Sharifi, Khavarian-Garmsir, A. R., & Asadzadeh, 2023). As an alternative to horizontal expansion, high-rise buildings reflect the concept of efficient development and support sustainable urban growth (Agyemang, Silva, & Anokye, 2018).

High-rise buildings in Indonesia are not only dynamic centers of commercial activity but also play an important role in addressing the increasing population density in large cities (Surya, Ahmad, Sakti, & Sahban, 2020). High-rise buildings in Indonesia have become a symbol of rapid progress in the development sector and the country's economic growth (Astarini & Utomo, Performance-based building design of high-rise residential buildings in Indonesia. , 2020). Not only creates a thriving business environment but also provides an alternative way to provide facilities and services to a rapidly growing population (Porter & Kramer, 2018). Utilizing vertical land in the city center with efficient high-rise buildings becomes the basis for sustainable urban development and is responsive to ongoing population growth (Al-Kodmany, 2018).

High-rise building planning requires a holistic approach that includes various aspects to create efficient, functional, and sustainable structures (Eichner, 2018). The initial planning stage includes identifying the main function of the building, whether as a business center, housing, or a combination of both functions (Bibri, Krogstie, & Kärrholm, 2020). Space management and zoning are the main focus, ensuring compatibility between architectural design and user needs. Construction cost analysis is key to determining the required investment, considering construction methods and material selection carefully (Erdogan, Šaparauskas, & Turskis, A multi-criteria decision-making model to choose the best option for sustainable construction management. , 2019). Affordability aspects must also be considered to ensure that the project fits within the available budget. Planning also includes the integration of environmentally friendly features to reduce environmental impact and long-term operational costs (Sodiq, et al., 2019).

Many difficulties could occur when there is a large demand for design services during the planning stage of a high-rise construction project. The augmented burden on architects, engineers, and design experts may result in timetable limitations, which may impact the accessibility of seasoned staff members (Park & Park, 2019). Delays may arise from the need for lengthier lead times when hiring specialized consultants. The fiercer the competition for resources such as trained workers, software, and design tools, the less quickly the essential resources are allocated (Hosseini, et al., 2018). Due to increased demand, contract negotiations with design firms can take longer, which could prolong the pre-construction phase in its entirety. There may be more design iterations and modifications in a fast-paced, highly demanded design environment as stakeholders offer feedback. Decision-making by the client may also be postponed as several initiatives compete for their attention.

The duration of the construction of a high-rise building is a crucial aspect that involves several interrelated factors. A high level of complexity and scale requires careful planning and implementation (Astarini & Utomo, Performance-based building design of high-rise residential buildings in Indonesia., 2020). Efficient project management, including good scheduling strategies, is key to optimizing time and minimizing the risk of delays. By holistically considering all these factors, high-rise building construction projects can be implemented efficiently and according to the specified schedule (Andiyan, Putra, Rembulan, & Tannady, 2021). Through this research, the author hopes to provide a comprehensive and quantitative analysis using bibliometric methods regarding high-rise building planning with data analysis using Publish or Perish and VOSviewer. This research will identify research trends, explore collaboration patterns between researchers, and spread the impact of scientific publications on related topics in the field. It is hoped that the results of this research will provide useful insights for researchers and practitioners in high-rise building planning.

METHOD RESEARCH

The methodology for this study will involve mapping different types of journal literature sources globally. The bibliometric data used in this study was gathered from academic publications about high-rise building planning. VOSviewer, Google Scholar, and Publish or Perish are the programs used in this study's data search methodology (Kurniati, Saputra, &

Fauzan, 2022). The author uses Publish or Perish to look for data, and then they use VOSviewer. Google Scholar has a feature that makes it simpler for researchers to search for papers by looking at the year of publication because many researchers use the database to publish their research.

Keywords relating to the research's core issue are used to discover past similar studies, utilizing Crossref as the primary source. The keywords will be evaluated and chosen for the goal of finding the most relevant studies; this process will be carried out using Publish or Perish and VOSviewer methodology that is being utilized to compare the related research using Publish or Perish and Vos viewer software. The connected studies will be searched using specified keywords in Publish or Perish, and the results of the most related research will be evaluated in VOSviewer using Publish or Perish data (Ariyanto, 2023). This method will be repeated as many times as necessary to locate the most relevant studies.

The data that will be determined, which are connected studies, are drawn from the top 1000 related studies or studies. Both Publish or Perish and Vos viewer software screen relevant research from 2000 to 2023 using keywords from the linked research as the filter component. The author uses software versions Vosviewer version 1.6.19 and Publish or Perish version 8.9.4538.8589.

RESULTS AND DISCUSSION

In this research, the author used VOSviewer version 1.6.19 software to visualize bibliometric networks. Apart from that, the author also uses the Publish or Perish software version 8.9.4538.8589 to access data according to certain keywords. The keywords used in this research are critical path method, program evaluation and review technique, planning, management construction, and high-rise building. Researchers conducted keyword searches over 23 years, from 2000 to 2023, so it can be ensured that the data used remains relevant to the objectives of this research.

By utilizing VOSviewer, researchers can produce in-depth visualizations of bibliometric networks, providing better insight into the relationships between topics or studies. Meanwhile, using Publish or Perish, researchers can not only detail the data based on certain keywords but also ensure the accuracy of the information by updating the data until 2023. The integration of the two software provides a strong methodological foundation, enabling a comprehensive analysis of the development of relevant literature throughout a certain period.

Relationship between keywords

The results of data processing using VOSviewer allow researchers to conclude the relationship between keywords in this research, as seen in Figure 1. This visualization is the result of data processing using VOSviewer, which relies on a database from Publish or Perish with the selection of relevant keywords during data processing. Figure 1 provides a graphical representation illustrating the relationship patterns between keywords, facilitating recognition and analysis of the structure and interconnection of information in the literature that is relevant to the focus of this research. As such, these visual results provide an important foundation for understanding the research landscape and sketching the dynamics of relevant topics during the period under study.

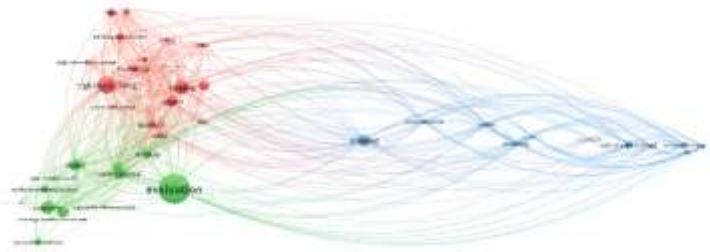

Figure 1
Relationship between keywords

From Figure 1 we can see that evaluation is the highlight in this analysis. This is very natural because in designing high-rise buildings using the CPM or PERT method, evaluation is an important process in decision-making. In Figure 1 it can also be concluded that evaluation is related to planning, implementation, performance, and scheduling. This attachment shows that evaluation is something that needs to be paid attention to in order to achieve optimal performance.

Density visualization between the keywords

In the density visualization processed by VosViewer with the keyword; Critical Path Method, Program Evaluation and Review Technique, Planning, Management Construction, High-rise Building. Based on these interrelated keywords, the author can make this literature show that there is significant density in the yellow areas. This shows that the previous authors have an attachment to the present which makes the density visualization very dense.

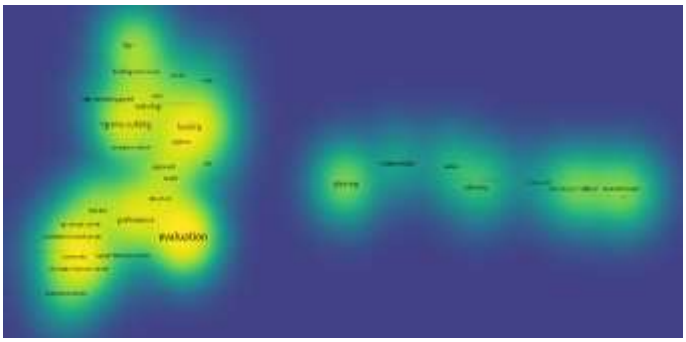

Figure 2
Density visualization between the keywords

Based on the visualization results from the Vosviewer, it can be seen in Figure 2 that areas that have density are related to the keywords chosen by the author. This density shows that the keywords have a deep relationship with the author's keywords. The largest density falls on evaluation followed by building, performance evaluation, high-rise buildings, and concrete. The results of this density visualization also show that the density in this keyword combines to create a dense and large area.

Total publications for the years

The database provided by Publish or Perish can also filter the total research data each year. This data helps authors select research that is still relevant so that it becomes research

that has an impact. From Figure 3, it can also be seen that an event occurred in a certain year, which caused the authors to do research in that year. What might support researchers writing in a particular year could be the influence of the emergence of innovations and technologies that make writers write their research. Figure 3 shows how much research has been successfully published.

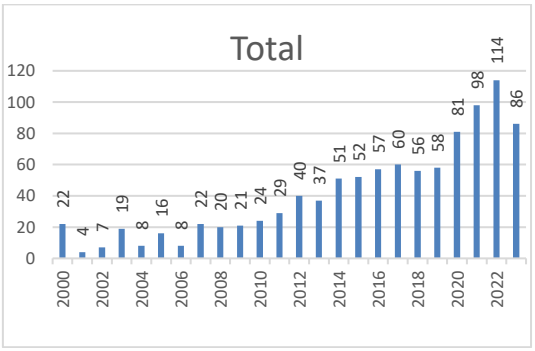

Figure 3
Total publications for the years

From Figure 3, it can be seen that the year with the highest number of studies occurred in 2022 with 114 studies. However, the initial increase occurred in 2020 with a total of 81 studies and was followed in 2021 with a total of 98 studies. The lowest research occurred in 2001 with four studies; this year was also the year with the lowest research in the last 23 years. What will be interesting will happen in 2023 with a total of 86 studies. This decline is unique because the COVID-19 period has ended, which should be an opportunity for writers to continue their research.

Organization Publishing Quantity

Publishers become intermediaries for writers to present their written works to the public. This shows that publishers are ready to develop knowledge for the world (Kleis Nielsen & Ganter, 2018). Based on the database, ten publishers are related to keywords, especially related to civil engineering. Publish or perish can also show which publishers have contributed the most to the author's keywords. From Table 1 it can be seen that the publisher that has research with the same interest in the author's keywords is Elsevier BV, with a total of 432 studies and a percentage of 65.90%. This states that the publisher Elsevier BV has a lot of research related to the author's keywords. In second place is Informa UK Limited, with a total of 75 studies and a percentage of 11.43%.

Table 1
Organizations Publishing

Publishers	Number of Studies	Percentage of Studies
Elsevier BV	432	65,90%
Informa UK Limited	75	11,43%
American Society of Civil Engineers (ASCE)	29	4,42%
The Korean Institute of Building Construction	22	3.35%

International Association for Automation and Robotics in Construction (IAARC)	21	3,20%
Japan Society of Civil Engineers	18	2,74%
Korean Institute of Construction Engineering and Management	15	2,29%
Scientific Research Publishing, Inc.	15	2,29%
Trans Tech Publications, Ltd.	16	2,44%
Emerald	13	1,98%

What's interesting about the publishers in Figure 1 are publishers in developed countries such as the United Kingdom, the United States of America, and South Korea. This shows his interest in civil engineering.

Studies Variation

Research can be written in variations. The diversity makes research unique and easy to access (Rowe, 2012). It's not just journals; there are also books, reports, and even monographs as research templates. Journal research seems more likely to be an option because it is faster and easier to access. Figure 1 shows what variations appear in VosViewer data processing.

Table 2
Studies Variation

Types of Studies	Number of Studies	Number of Citations	Percentage of Studies
Journal-article	774	20383	85,33%
Proceeding-article	75	110	8,26%
Book-chapter	49	12	5,40%
Posted-content	6	0	0,66%
Book	1	1	0,11%
Report	1	0	0,11%
Monograph	1	0	0,11%

In Table 2 Journal-articale is the choice of researchers to write their research, with a total of 774 studies, 20,383 citations, and a total of 85.33%. Followed by proceedings-articles with a total of 75 studies, 110 citations, and a total of 8.26%. Journals are an option because they can be accessed quickly and easily. This does not rule out the possibility of writing research in the form of books, reports, and monographs.

CONCLUSION

Based on the data above, the construction of high-rise buildings is the right choice to overcome population density and lack of land. From the visualization results of VosViewer software with publish or perish data, evaluation is the most related thing between the author's keywords. Density visualization shows the relationship and density of each author's keywords. From data processing from 2000 to 2023, it is known that there is growth every year with a

peak in 2022. Research also tends to be in the form of journal articles with a total of 774 studies (85.33%) where 432 studies are dominated by Elsevier BV (65.90%). It can be concluded that high-rise building planning with CPM and PERT methods can still be developed in the future.

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