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Bibliometric Analysis of Productivity Instruments in Construction Management Project Management Using VOSviewer

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Abstract: *In this study with the topic of productivity tools in construction management, project management uses bibliometric analysis as a method for analysis. With heavy equipment keywords, tool productivity, project management and bibliometric analysis through Publish or Perish software is used as a network liaison between journals related to this research topic. Through this software in the period from 2000 to 2023 can produce 1000 interrelated journals, the results of networking through Publish or Perish are then taken and processed through VOSviewer software using RIS (Research Information Systems). From these results, it was obtained that the keyword "analysis" became the most keyword from 1000 interrelated journals. 2021 is the year when the research produced is 92 journals where the research journals are related and inter-netted with existing keywords in accordance with this study.*

Keywords: *Machine, Productivity Instrument, Project Management, Bibliometric Analysis.*

INTRODUCTION

Generally, construction equipment, such as heavy equipment, is a crucial instrument for achieving a project. At first, humans used stone and wood to make simple structures such as huts; in the late 18th century, humans began to use steam engines to make and mass-produce materials such as bricks and wooden blocks. Until the 20th century, more sophisticated and modern construction equipment began to be created, namely heavy equipment such as excavators, bulldozers, cranes, and others, which play an essential role in implementing a construction project. Not to be outdone by heavy equipment, digital construction tools such as BIM (Building Information Modeling) and other construction tools that use drones are increasingly used to speed up or improve construction, especially in areas such as mountains. BIM is a set of technologies, processes, and policies whose entire process runs collaboratively and is integrated with a digital model. The use of BIM in construction work.

Construction equipment in Indonesia had existed since the Dutch colonial era in the 17th to 19th centuries when simple tools such as cranes and trucks were still used to build railways. Developing construction equipment in Indonesia has grown since the influence of modernization and globalization. The purpose of using heavy equipment is to facilitate the work of the community and facilitate the achievement of the desired results in a relatively short time (Turalaki et al., 2018). Equipment such as excavators, bulldozers, loaders, graders, and others are commonly used in infrastructure development in Indonesia. Mountain areas are areas where it is not easy to identify a location or situation.

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Machines are critical components that can help workers handle heavy tasks more efficiently and effectively. Judicious use and proper maintenance are also crucial for the success and safety of

the project. One of the most essential activities that incur high costs in a company is maintenance; in mining, heavy equipment is one of the vital maintenance tasks (Afiyuddin & Sudiarno, 2021). Routine maintenance is also essential so that the tool can operate correctly and efficiently for an extended period, and other functions are also to maximize tool life, reduce risk, ensure time in the construction process does not exceed the given target period, and optimize tool performance. Like the equipment used, maintenance is certainly essential; maintenance is mandatory because it will be damaged if it is not done. Some of the maintenance goals are saving more significant repair costs, reducing fuel costs, increasing productivity, reducing downtime, not increasing construction time, and also complying with clothing regulations.

In the construction sector, heavy equipment is ubiquitous because it can make it easier to carry out construction projects. Construction projects used to be done manually but took a long time, but over time, they can be accelerated with the help of heavy equipment. Heavy equipment is an essential factor in large-scale construction projects (Kaprina et al., 2018).Construction equipment is equipment or machinery used in the construction sector during a project's construction, repair, or renovation process. Construction tools are also very helpful in speeding up and simplifying work and increasing the efficiency of project work in a short time.

increase productivity, and accelerate construction progress. Some commonly used tools are excavators, bulldozers, loaders, graders, pavers, crushers, compactors, etc. Excavators are versatile tools that can be used for different types of jobs such as digging soil, making ditches, dredging rivers, knocking down buildings, loading materials onto dump trucks or timber onto trailers, etc.(Anggriawan, 2020).

This section describes the research methods used and the stages of research (in the form of a stream or chart). This study used bibliometric visualization methods and bibliometric analysis. As a quantitative method, bibliometric analysis uses evaluative and descriptive approaches to represent trends and research characteristics from a series of publications (Sanusi et al., 2023). In this study, bibliometric analysis aims to discover the characteristics of particular literature. The analysis also uses data such as author name, title, journal name, year of publication, and others to evaluate and provide evidence of distribution in scientific research. Another purpose of bibliometric analysis is to compare the productivity of different studies by analyzing the number of publications, assess the quality of journals by analyzing the number of citations received, and help identify areas of research by analyzing publications in their fields. In research, bibliometric analysis is carried out using VOSviewer. VOSviewer is software used to analyze bibliometric data. VOSviewer is very useful in the context of research and scientific studies. This software is very famous among researchers because it provides insight into the structure and development of scientific literature.

Heavy equipment, which is the backbone of the construction world, has changed the landscape of construction work and related industries. This research is based on several opinions of experts in the construction field and a review of several studies on heavy equipment (Setiawati & Meddeppungeng, 2013). Through its prowess and power, heavy equipment not only speeds up construction projects but also becomes the key to completing heavy, complicated, even impossible jobs for humans. Heavy equipment is a large machine designed to perform construction functions such as earthmoving and transportation of construction materials. Heavy equipment usually consists of five elements: tools, traction tools, structures, power sources and drive systems, and control systems. Carrying out construction work using heavy equipment requires careful planning so the project can be carried out at optimal cost and implementation time.

Therefore, it is necessary to analyze the use of heavy equipment to produce suitable alternatives for the project's development. Heavy equipment is the most crucial element in carrying out large-scale construction projects and is intended to expedite work and complete it in a short time (Septiani et al., 2019). The selection of heavy equipment to be used has a significant impact on the smooth running of a construction project. The machine used must be suitable to ensure the smooth running of the project or work (Jaya & Sutandi, 2019). Infrastructure development continues to develop along with population growth and technological advances. Different areas of development are under

development, including roads, buildings, bridges, canals, and other constructions. To support the development plan, new or alternative paths must be added, such as constructing access roads. The construction of good roads and friendly traffic plays an essential role in the economic, political, and social fields. Road quality is due to the influence of materials, operators, and machine use, and the results are on schedule and completed within the stipulated time. The use of heavy equipment has a significant impact on the progress of activities. Incorrect selection of large equipment will reduce productivity and incur additional costs when carrying out repairs or procuring other large equipment (Nugraha et al., 2018).

Once the project begins, the contractor selects the heavy equipment to be used for the project. The selection of heavy equipment to be used is one of the determining factors for the success of a project. So, choosing a suitable machine is necessary to ensure the project runs smoothly. The project may not run smoothly if you choose the wrong machine (Suprihatin et al., 2018). The success of a construction project can be measured from two things, namely the benefits achieved and the timeliness of project completion (D. H. Putra, 2018). The machine must be used effectively and efficiently. Therefore, you need to know the tool's features, the tool's type, the tool's production capacity, and the tool's operational cost (Amin, 2022).

Heavy equipment is the most crucial element in large- scale construction projects and is intended to expedite work and complete work quickly (Supit, 2020). The use of heavy equipment is essential for accelerating the implementation of road repair work in accordance with predetermined targets. For this reason, it is necessary to analyze the productivity of equipment on a project. It will be constructive in determining the working time of equipment so as to produce the effectiveness of resources, both the equipment resources themselves and other resources, so that these activities can be completed according to the planned time. Heavy equipment in construction projects plays a significant role therefore understanding the types of heavy equipment is very necessary, especially in the planning stage, because the selected heavy equipment must be in accordance with the needs of the project (Febrianti & Zulyaden, 2018)

Heavy equipment has an essential role in speeding up work (Jaya & Sutandi, 2019). The greater the production capacity of each heavy equipment unit, the higher the machine's efficiency achieved under reasonable operating conditions. Conversely, if the production capacity is low, the efficiency of the heavy equipment used will also be low (Nugraha et al., 2018). Heavy equipment is a crucial element in large- scale construction projects. The price of heavy equipment is not cheap, so companies need to manage financing so as not to experience losses, choose the type of heavy equipment according to time and division of labor, and ensure project cost efficiency (Said & Musa, 2022).

The development of construction projects plays a major role in environmental changes that occur today (Octavia & Putra, 2022). When choosing which machine to use, it is important to consider four things: engine power, load capacity, cycle time, and operator factors. On the other hand, equipment effectiveness depends on several aspects such as machine operator skills, equipment selection and maintenance, equipment planning and location, terrain, weather conditions, and methods. Application (AHMAD, 2022). If the productivity of your machine is not optimal, it can be not good for your business. Machine productivity is determined by bucket capacity, cycle time, and production correction factor (Prasmoro & Hasibuan, 2018).

In the construction industry, heavy equipment is essential to meet the demands of the job. The use of heavy equipment on projects allows people to get work done and save time (Ramadhan & Nugraha, 2018). Productivity is the relationship between the results achieved (outputs) and the resources used (inputs). In other words, effectiveness refers to achieving maximum work through effort or how it is carried out. One factor affecting work productivity is the selection and use of the right heavy equipment (Sahid et al., 2021). The tool's effectiveness depends on several aspects, including the skills of heavy equipment operators, tool selection and maintenance, tool planning and placement, terrain, weather conditions, and implementation methods.

Construction projects in Indonesia continue to grow and increase over time. This shows that more and more developments are happening in Indonesia (Victor & Simanjuntak, 2021). A construction

project is a set of activities carried out only once and usually within a short period (Fahmi et al., 2020). Project management is needed as a control tool to ensure that all actions can be performed efficiently (Simanjuntak & Baskoro, 2020). A skilled and skilled workforce is needed to meet the demands of significant growth in the construction industry (Herzanita et al., 2021).

Project management is the process of systematically implementing management functions (planning, execution, control, coordination) on a project, using existing resources effectively and efficiently to achieve project objectives optimally (Wibowo & Rozy, 2020). Risk management is the systematic process of planning, identifying, analyzing, responding to, and monitoring project risks (Moi & Purnawirati, 2021). Each project has characteristics which vary from project to project. Various characteristics of this project have an impact on the progress of implementation efforts in the field (Sutomo et al., 2020). To minimize the risks that arise, companies must implement appropriate risk management to avoid loss of time, cost, and project quality (Samudro et al., 2020). A sound construction stage is also needed to support the possibility of improving building physics. These phases are interrelated, from workflow to planning and optimization of available resources to financial monitoring of the project (A. P. Putra et al., 2022).

The research objectives of this study aim to address the challenges and enhance the efficiency of construction project management in Indonesia. The primary objectives include identifying the factors contributing to delays in project implementation, assessing the impact of project characteristics on implementation progress, analyzing the risks associated with construction projects, and proposing effective risk management strategies to mitigate time, cost, and quality-related losses (Hansen & Anondho, 2019; MEGAWATI, 2021). Additionally, the study seeks to explore the correlation between construction stages, workflow optimization, resource planning, and financial monitoring to improve overall project performance (Prihantara et al., 2018; Putri & Bobby, 2020). Furthermore, the research aims to evaluate current project management practices, including data utilization and documentation, to propose recommendations for optimizing project management processes. Ultimately, the study endeavors to contribute to the achievement of project objectives within specified timelines and budgets amidst the challenges posed by system dynamics, human factors, and technological influences on project success.

MATERIALS AND METHODS

The methodology used in this study was to use identification information from various research journals around the world. Currently, the use of technology is very advanced, and it makes it easy to find all kinds of information from various sources around the world. For example, in terms of bibliometric analysis directly when mapping research results from various scientific journals. Bibliographic analysis is an analysis that describes and maps scientific studies in a structured manner using article/journal metadata (Marwantika, 2022).

The objectives of bibliographic analysis according to (Donthu et al., 2021) are (1) to obtain an overview of research trends, (2) to identify knowledge gaps, and (3) to provide information for future research, ideas, and (4) to position scientific contributions. One of the mapping methods used in this study is the bibliographic method, which routinely targets journal studies.

The use of technology, especially digital data, has become widespread. Digital literacy refers to a person's knowledge and ability to use media, means of communication and digital-based networks wisely and appropriately and obey the rules of both laws and other existing regulations (Zainuddin et al., 2023). One of the characteristics of writing scientific papers is that citations from various sources, such as journal articles, books, and other sources, appear in the "References" or "Further reading" sections.

RESULTS AND DISCUSSION

Relationship between keywords

which can be seen from the image below (figure 1). This data is obtained through a database on the Publish or Perish application and then sorted to produce the following relationship. Keyword

selection also touches on the many relationships between keywords.

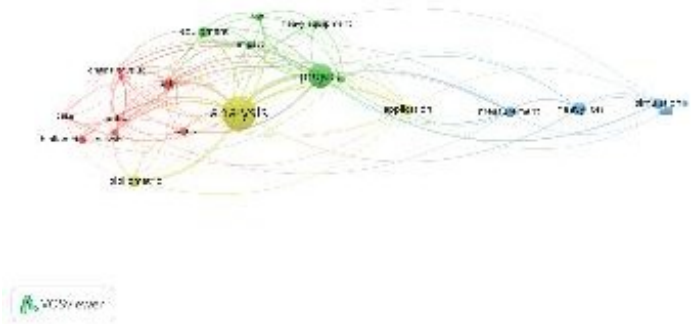

Figure 1. Network Keyword Visualization

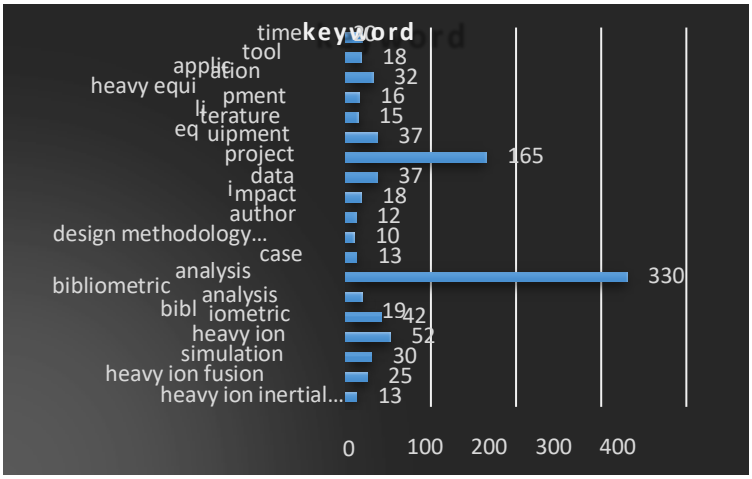

Figure 2 Keyword graph by event

Research developments from each year

The year of study is one of several results required in research. From this database (Figure 4) we can then sort and process the data in order to count the number of publications each year. The results of the research publication will be shown in the following graph.

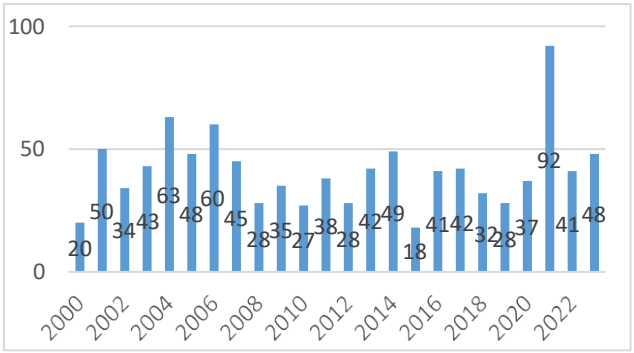

Figure 3. Research data from various years

The data from the figure above (Figure 3) is data from 1000 studies from between 2000 and 2023. This data shows that the curve in the study of 23 resulted in an increase and decrease over the year. In 2021 we can see from the graph that the research produced was 92 journals and in 2015, the

previous 6 years only produced 18 journals.

Research author's citation

The quality of a paper can be assessed based on the relationship between the research topic and the number of citations. The number of citations and the significant relationship between citations can also be an indicator of the success of scientific research. Research with a large number of citations can be said to be research that is closely related to the research theme.

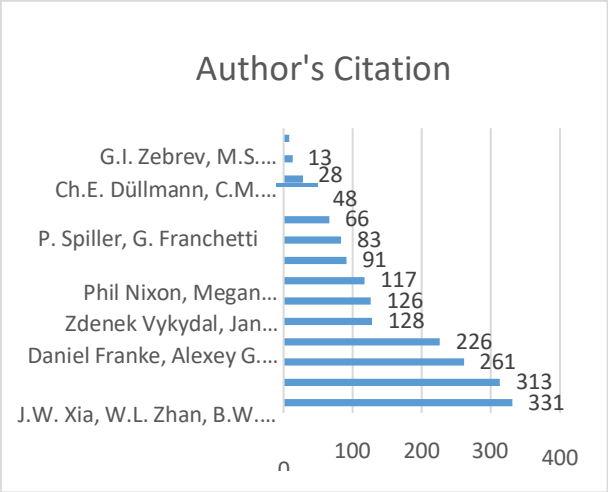

Figure 4. Author graph with number of citations

From the graph above (Figure 4) it can be seen that the research produced by the authors produced 331 citations. This means that many of their studies were very influential and helped in the creation of these studies.

Density of visuality as a keyword

From the results of keywords obtained through the use of vosviewer software, previously sorted visualization results were obtained and the following image was produced (Figure 5). From this visual, it can be seen that analysis is the most dominant keyword.

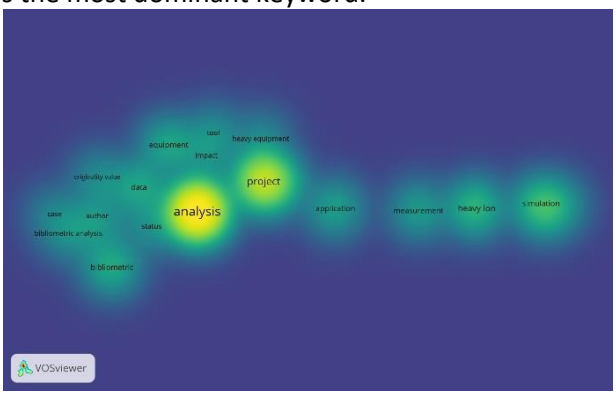

Figure 5. Visual Density Keyword

Author density of visuality

This visualization will show the density between authors obtained from Publish or Perish software. From this data, we can see the relationship between the authors. The relationship between the authors' journals can also be seen in the picture (figure 6). The brightest colours in the image show the most contribution to the study.

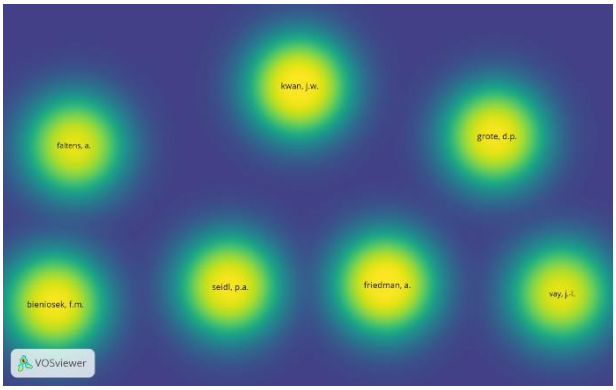

Figure 6. Density Visualization Author

Case study from several countries

As is well known, the authors of the study came from various countries and continents. From the table and figure (figure 7) below can be seen the country of several studies. This data is obtained by taking several studies by grouping the journals discussed by the author.

Table1. of the number of studies from different countries

Country/Continent	sum
Indonesian	7
Chinese	7
Korean	7
Asia	7
India	5
America	7
Australia	5

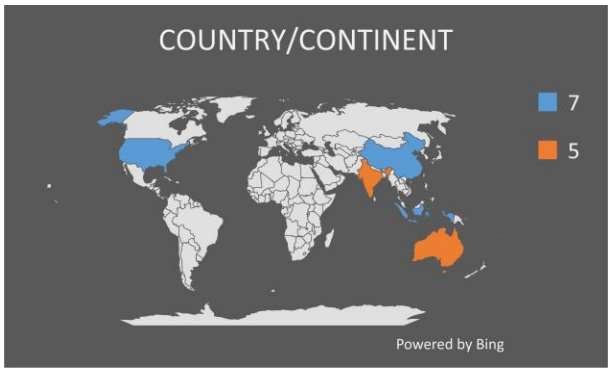

Figure 7. Country part of the author

The table above shows that Indonesia, Korea, China, Asia, and America have the same amount of research, even more than India and Australia. It seems that there are also several studies in other countries, but the numbers cannot be found; from here can be seen the development of research journals in the world.

CONCLUSION

In this study, bibliometric analysis was used. This analysis is used to cover the dissemination of research journals by capturing keywords. Publish or Perish also assisted this research as a summarizer of 1000 journal networks from 2000-2023. The topic created in this study is productivity tools in construction management and project management. Through Vos Viewer software, it was determined that the keywords Analysis and Project are the most dominant keywords among other keywords.

However, even so, other keywords also remain connected within the scope of this study. From a span of 23 years, it is known that in 2021, it produced 92 journals related to this research keyword, and in 2005, it only produced 18 journals. The spread of research networks from various worlds certainly always exists. Therefore several linkages are obtained between journals from various countries to continents, such as Indonesia, Korea, India, and China, and from several continents, such as Asia, America, and Australia. Through this visual network, it can be concluded that the following research on the topic of productivity tools in construction management project management will always and continue to proliferate until the following year and spread widely to all corners of the world so that scientific progress continues to run and increase.

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