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# Blockchain Technology in Wood Raw Material Supply Chain Management – A Bibliometric Analysis and Review

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**Abstract.** Supply chains in today's global era generally have complex entities consisting of multi-echelon, dynamic, long chains, and geographically separated entities. Globalization in SC become increasingly complex when dealing with diverse regulatory policies because SC entities are located in different countries, accompanied by varying cultural behavior and human consumption. Complexity in SC networks often results in inefficient transactions leading to increased risk and distrust. These conditions lead to a need to share information that is more transparent, traceable, and verified. The use of blockchain technology as a tangible form of digital technology advancement can be utilized to effectively store traces of information and simplify the entire process of business transactions. This technology appropriate for processing wood distributor companies that have many suppliers and customers, both retailers and individuals who often demand clarity on the origin of woods being sold. Blockchain technology has public access system, can be applied to transparently track the information of wood in realtime between the parties concerned. With blockchain technology, companies can carry out transactions with shorter processing times and access information in a faster time because they're integrated with each other. This paper aims to propose a conceptual framework that defines the capabilities of blockchain technology that allows collaboration between various parties concerned such as aligning all consumer demand with supply of goods from suppliers in real-time in order to improve supply chain management performance of companies engaged in the commercial wood raw material industry.

## INTRODUCTION

In the last two decades, information technology is constantly evolving and evolving. Information technology is a technology that has an important function in processing, processing, obtaining, compiling, storing, and converting data through various ways to obtain useful or quality information [1]. Digitization can be done to achieve the benefits of supply chain 4.0 in the wood manufacturing industry [2]. Meanwhile, another study also reviewed the use of blockchain technology for unaltered distributed ledgers in operations and wood supply chains [3]. In addition, there are also studies that explain how blockchain technology can overcome and help create supply chain sustainability, especially in the wood industry [4]. In another study, it is explained how blockchain traceability solutions through Internet of Things (IoT) technology and smart contracts can affect the visibility of various wood industry supply chain network designs [5]. Furthermore, blockchain technology in the form of smart contracts can be applied to reduce transaction costs, transaction processing time, and law enforcement in the maritime supply chain related to the timber industry [6]. Blockchain technology can be applied to log tracking systems to perform online digital tracking of global companies [7]. Meanwhile, it also explained about the application of blockchain technology to trace the origin of wood products to help ease the work of a company's wood procurement officer, to how trust is created between suppliers and buyers [8]. The current research paper will propose a conceptual framework that defines the capabilities

of blockchain technology that allows collaboration between various parties in real-time on a blockchain system to improve supply chain management performance of companies engaged in the commercial wood raw material industry. This research is important to do because the use of blockchain technology design in the supply chain management of a wood raw material company is expected to improve transparency, traceability, efficiency, real-time collaboration, real-time information, and trustability between all parties concerned. This paper focuses on identifying, analyzing, and combing through various previous papers related to the use of blockchain technology in supply chain management activities. In addition, the author hopes to offer some recommendations for future research and provide some suggestions for business companies who want to apply blockchain technology in the real world, especially in the wood industry. This study will conduct a systematic and objective review based on the analysis of literature data reviewed using the bibliometric literature review analysis method.

## REVIEW METHODOLOGY

The review methodology used in this paper is the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method, which means that a quality review process is carried out systematically by following the appropriate steps. The PRISMA method involves stages such as determining the title, presenting the abstract, analyzing the background and explaining the urgency of the review in the introduction section, outlining the review methodology, stating the results and discussion, and drawing conclusions. The literature review study will be carried out systematically and objectively, based on the analysis of the literature data reviewed using the bibliometric literature review analysis method. The search strings used in this paper are four (4) main keywords, namely blockchain, supply chain, wood, and timber. There is a database of 650 articles that were found using the specified keywords, which were then filtered into the remaining 142 articles based on the fulfillment of the 3 basic criteria set, including publisher, year of publication, and number of citations, and then taking into account relevance in reviewing articles. 12 main papers have been selected which will be the focus of the study in this research. In the last section, a discussion of the conclusions, opportunities for further research in the future, and limitations are given.

## RESULTS

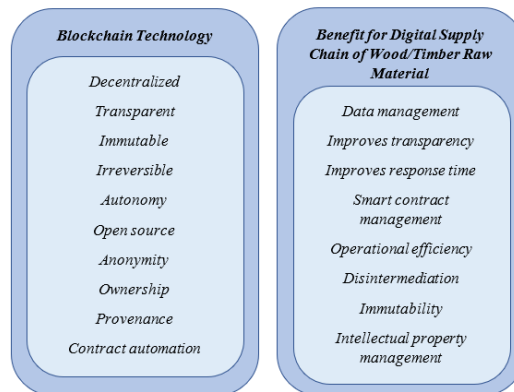
In the field of bibliometric analysis, research projects that are described in the body of scientific literature are assessed by counting specific markers. This makes it easier to find the authors and institutions that are most active and frequently cited, the publications that are most pertinent to the field, and the keywords that are used the most. Article selection is done through several criteria fulfillment. The selection of articles that meet the specified keywords is done using the Harzing Publish or Perish 8 application which was accessed in May 2022 based on the Google Scholar database. There are three (3) basic criteria that determine article selection, namely publisher, year of publication, and number of citations. The publishers of the articles chosen by the authors are official publishers who have published many indexed journals, such as the Institute of Electrical and Electronics Engineers (IEEE), Elsevier, Institute of Materials, Minerals & Mining (IM3), MDPI, Springer, IOS Press, Taylor & Francis, Sciendo, and SSRN. Then, the next criterion is related to the year of publication, where the selected articles are articles published within the last 10 years, namely between 2012 and 2022. In addition, there is also a criterion for the number of citations in which the selected articles have quoted more than or equal to 10 citations based on other previously published research journals.

The search for articles is carried out using four (4) main keywords, namely blockchain, supply chain, wood, and timber. Of the 650 journals found in the search results using the Harzing Publish or Perish 8 application using these keywords, it is known that based on the basic criteria previously mentioned, there are 142 articles that meet the basic criteria, and the research titles are relevant to each keyword. independently used. Furthermore, the article will be selected again to be used as the main paper and must have a relationship between the application of blockchain design in the wood/timber supply chain. Of the 142 articles that meet the basic criteria, and taking into account the relevance in conducting article reviews, 12 main papers have been selected which will be the focus of the study in this research. The selection of 12 articles that were used as the main reference papers to be studied in this study was based on an analysis of the title and content of the paper in question. Elimination is carried out by researchers by combing through all papers (142 articles that have met the basic criteria), to only select papers that have a structured and clear title according to the research topic studied by the researchers in this study, and analyze the content of the paper which is clearly related to the research topic. In this study, only 12 articles were selected to be used as references for the main paper in this study.

## DISCUSSION

The immutable distributed ledger technology (DLT) known as blockchain is utilized in shared and synchronized environments where all transactions are validated by all users and are trackable [9]. This makes it possible for a decentralized setting in which all network users can communicate safely without the requirement for a trusted authority. A decentralized digital ledger called blockchain can be used to establish contracts since it has a wide range of features, track goods, and make payments [10]. Blockchain technology can eliminate risk by providing a consistent and complete database [11]. According to Dickson, the supply chain is the network of locations where goods are manufactured and delivered, from the source of procurement to the end user. It is challenging to follow an event along the supply chain because it consists of so many different places and stages. Buyers and customers are unable to determine the genuine worth of the given goods or services due to a lack of transparency. It is challenging to determine who is accountable for the illicit events that take place in the supply chain network. This may be the cause of the ongoing issues with counterfeiting, forced labor, and poor working conditions in factories and businesses. Blockchain technology provides a fix for supply chain problems in relation to this issues, especially in the context of the supply chain of wood raw material products sold by companies [10]. The supply chain for wood and lumber can greatly benefit from even the most rudimentary application of blockchain technology. The use of blockchain applications in the supply chain management of wood raw material products from the forestry sector to companies engaged in the wood industry is very much, of course related to forest management, wood management, and traceability of forest-based products. In a recent study, a blockchain-based information sharing system was created to track the movement of expensive wood along the supply chain and trace it back to assure its quality and authenticity [12]. It is simulated how wood travels through the supply chain until it arrives at the customer's location as the finished product. RFID technology is used to track each tree along its supply and processing chain, from forest stands to businesses.

Blockchain's usage of immutable data records, distributed storage, and regulated user access can significantly worsen supply chain transparency difficulties [9]. Because of the transparency of blockchain technology, it is possible to follow and document a product's path from its place of origin through the point of delivery to the customer. All parties engaged in the supply chain can therefore access the information. The network of parties involved in the supply chain can thus become more trusted as a result of information openness. All stakeholders have certainty thanks to the blockchain's immutability that no malevolent actors will be able to alter any of the activities that are recorded on the network [13]. This is made feasible by the blockchain's recording and auditing features as well as nearly real-time transaction tracking [14]. The implementation of blockchain-based smart contracts in the supply chain can decrease extra costs and delays, which will result in a more effective and reliable supply chain by reducing human error, extra expenses, and delays [15]. Supply chain performance will undoubtedly increase with greater supply chain openness [16]. The supply chain business can benefit substantially from the use of blockchain technology, particularly in the area of traceability [17]. Each player in the supply chain can remotely track every piece of information by applying blockchain technology, including the quality of raw materials, the timestamps of commodities moving through the supply chain, and different parties participating in manufacturing and distribution. Traceability can boost consumer confidence and product safety [18]. The system may decide which wood product should be discarded if any faulty wood products make it to the consumer without endangering the entire product line. The results of the break down framework for wood/timber digital supply chain using blockchain technology can be seen in Figure 1 below.



**FIGURE 1.** Decomposed framework result for the wood/timber digital supply chain using blockchain technology

## Sector, Methodology, and Output Analysis

In this sub-chapter, an analysis of the categories of scope of discussion, the methodology used, and the research outputs produced from the 12 selected articles is carried out. All 12 articles are in the same type of supply chain sector, namely the wood sector or timber supply chain. Meanwhile, the methodology is divided into three (3) methods, including analysis, design model and implementation, and bibliometric literature review. The determination of the scope category and methodological grouping as well as the output analysis based on the 12 articles that have been selected. Based on 12 selected articles relating to the application of blockchain in wood or timber supply chains, an analysis of the objectives and output results of each research can be carried out which of course differ from one another.

### Keywords Analysis

Of the 12 articles selected, there were 42 different keywords. The keyword that most often appears is blockchain technology with a percentage of 15.2542%. Then, in the next order, namely supply chain keywords with a percentage of 6.7797%. Then, followed by the keyword traceability with a percentage of 5.0847%. Furthermore, there are four (4) keywords that have the same percentage, namely transparency, Distribution Ledger Technology (DLT), forestry certification, and digitalization keywords, each of which has a percentage of 3.3898%. The rest, there are 35 keywords that occupy the same percentage of 1.6949%. There are as many as 3 articles that do not include blockchain keywords in the keywords section. However, it is clearly known that in the overall discussion of the three articles the context of the application of blockchain technology in the supply chain, so that the three selected articles still meet the researcher's criteria.

### Future Avenues Analysis

In this sub-chapter, analysis related to future research is carried out by 12 selected articles. The grouping is divided into supply chain sectors category, topic, and methodology. The suggested methodology that can be used is divided into four (4) kinds of methods, including methods of analysis, case study, design and implementation, and bibliographic literature review. The analysis method can be carried out on data, concepts, models, uses, or processes. The case study method can mean qualitative research through empirical tests carried out directly on existing conditions. Design and implementation can be interpreted as observing or analyzing the model to be created and programming the model into an application on the blockchain. Finally, bibliographic literature review is research in the form of a review of existing articles. In terms of supply chain sectors category, various categories of supply chain sectors are mentioned in accordance with each existing research.

## CONCLUSION

Based on all the discussions that have been carried out, it can be concluded that blockchain technology is a distributed ledger technology (DLT) with immutable data, used in a shared and synchronized environment where all transactions are validated by users and can be traced very usefully in timber trading, which requires transparency and validation of the origin of the wood. The use of blockchain technology in the supply chain management activities of the wood raw material company can play a very important role in aligning all consumer demand with the supply of goods from suppliers in real-time. The application of blockchain technology allows collaboration between various parties in real-time on a blockchain system to improve supply chain management performance of companies engaged in the commercial industry of digitalized wood raw materials, where the entire journey of wood raw material products can be tracked so as to increase transparency, traceability, efficiency, real-time collaboration, real-time information, and trustability between all parties concerned.

In this study, the selection of articles was carried out using the Harzing Publish or Perish 8 application based on the Google Scholar database by determining the appropriate keywords, which were then visualized using the VOS Viewer application. There is a database of 650 articles found using the specified keywords, which are then filtered to the remaining 142 articles based on the fulfillment of the 3 basic criteria set, namely publisher, year of publication, and number of citations. Furthermore, taking into account the limitations in conducting the review of articles, 12 main papers have been selected which will be the focus of the study in this study. By using the 12 selected articles, scope category analysis, methodology (analysis, design model and implementation, and bibliometric literature review), and

output analysis were carried out. In addition, keyword analysis was also carried out, where the three (3) keywords that most frequently appeared were blockchain technology, supply chain, and traceability. Furthermore, the future research analysis listed for each article is also provided. In further research, the researcher plans to implement blockchain technology design in the supply chain management of wood raw material companies which can be expanded in the context of the relationship between suppliers and buyers to an international commercial scale, which is related to import and export activities of wood raw materials which can also consider manufacturing aspects. In addition, it is hoped that this research can assist researchers in conducting future research that discusses the use of blockchain technology designs in wood/timber supply chain management of a company. The recommendations given in this study certainly have limitations, so the researchers hope that they can start more research and discussions to discuss important points related to this research topic in the future.

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