

Scientific Evolution of the Concept of Integrated Transport System in Meta-Analysis

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Abstract

This study aims to analyze the scientific evolution of the integrated transport system concept in a meta-analysis. This study applies a qualitative approach that utilizes scientific development to various scientific journal publications on the idea of an integrated transportation system. Scientific journal data analysis was developed through scientific evolution with a meta-analysis approach to obtain knowledge mapping. Bibliometric analysis is implemented in a meta-analysis approach followed by applying relevant procedures in analyzing the concept of an integrated transportation system for the development of knowledge and technology. The analytical technique in this research is a bibliometric analysis by developing the VOSviewer program based on the concept of an integrated transportation system under study. The initial step is to collect databases from various sources of scientific journals so that multiple journals that are relevant to the proposed theme are obtained. Based on the results of the analysis by developing the VOSviewer program based on the concept of an integrated transportation system, articles related to the integrated transportation system from 1948 to 2021, it can be concluded that several keywords become the core of this field of study, including Policy Implementation, Social Welfare, Sustainable Transport, Public Participation, Planning, Development.

Keywords: Meta-Analysis, Scientific Evolution, Transportation, Integrated, System.

A. INTRODUCTION

An integrated transportation system (Integrated Transport System/ITS) needs to involve combining various modes of transportation to increase efficiency and seek convenience for consumers, especially concerning comfort, safety, time, cost, accessibility, and convenience (Rybicka et al., 2018; Ma et al., 2018). The diversity of transportation modes in an integrated system has different technical capabilities and operational procedures. Each method of transportation is expected to develop according to its capacity and specifications to meet consumer needs in an integrated transportation system (Kazaryan, 2018; Diana et al., 2018). In addition to the existing competition in the integrated transportation system, there will also be complementary needs between modes to help consumers become more interactive so travel access needs can be met. The existence of an integrated transportation system that is successfully implemented will be able to have an impact on increasing

consumer demand in the public transportation sector, especially in efforts to reduce congestion and pollution (Aziz et al., 2018; Sipus & Abramovic, 2018).

Currently, the concept of an integrated transportation system is starting to be widely applied in many cities worldwide to support sustainable urban development (Cabrera et al., 2018). The existence of various problems in the concept of an integrated transportation system, including the issue of unpreparedness of an integrated transportation system in dealing with emergencies, the main difficulty in managing the risks that exist in an integrated system is the lack of internationally recognized standardization to be able to provide structured guidance for risk management in the management system. In an integrated manner, a substantial organizational change is needed in integrated transportation management that aims to examine the demands and thoughts of users of transportation services, the occurrence of unfair competition between the resources involved in an integrated transportation system, and the lack of supervision in an integrated system, the existence of austerity and competition policies have made local public transport fragmented and less attractive to consumers (Broaddus, 2020).

To solve various problems that surround the integrated transportation system, it is necessary to develop solutions that can help overcome multiple existing issues, including the need for administration of the transportation system following the needs of the latest technology to change the way of making decisions, especially those related to response speed, resilience to changes in demand, and the need for new policies, integration in land use and transportation can produce positive values, especially accessibility and quality of life in big cities which are experiencing rapid growth through balancing restrictions and providing incentives to control the quality of regional development as well as creating cost-saving strategies to maintain environmental quality. Farahani et al., 2019; Abramovic et al., 2020).

To reduce inaccuracies due to insufficient spatial resolution of the model, it is recommended to use smaller raster cells to increase the number of zones by increasing the size of the matrix in saving travel time through the use of skim tables in transport modeling, the simplified route network of transportation modes results in uncomfortable conditions. so that a multi-criteria approach is needed with a relatively complex route network that considers fleet and cost reductions and increases convenience (Odogun & Georgakis, 2019).

Integrated transportation systems are currently being developed to support the sustainable development of urban areas by utilizing the latest technology and quality resources (Norouzian et al., 2022; Harrison et al., 2020). The formulation of the problem developed in this research is how the concept of an integrated transportation system published in scientific journals can be mapped and analyzed, which refers to scientific evolution to obtain several topics that have novelty as an effort to develop sustainable cities (Jaller et al., 2020; Siqueira et al., 2021). The expected objective of this research is to map and analyze the concept of an integrated transportation system to produce various topics or research variables that have novel value so that they have an excellent opportunity to be developed and

researched further. Research topics or variables that have novelty values obtained in this study can be in numbers that have been widely published in various fields in scientific journals or those that are rarely published but have the potential and opportunity for further research by researchers or academics.

B. LITERATURE REVIEW

1. Integrated Transport System

An integrated transportation system is a traffic and transportation system that embodies the cooperation, organic integration, communication, and layout of various transportation methods with technological and economic features in the transportation sphere. In addition, Young et al. (2020) also explained that the integrated traffic and transportation system is a complex dynamic system consisting of transportation network equipment, carriers, passenger and cargo flows, and organizational management for various means of transportation. An integrated transportation system embodies completeness between modes of transportation, equipment, enterprises, adaptability to economic and social development, and unity of physical and logical relationships so that transportation productivity can develop to the next stage (Winston, 2020). The concept of an integrated transportation system emphasizes the interconnectedness of various transportation facilities with the vital point of infrastructure integration to encourage network integration to provide ease of transfer to different modes of transportation where the main concern is an integrated transportation system and services to provide transportation accessibility and smooth travel (Mogaji et al., 2022).

An integrated transportation system is one of the solutions to promote sustainable mobility and equitable transportation. An integrated transportation strategy utilizes a combination of infrastructure, management, and pricing to achieve better performance to achieve transportation policy objectives. In designing and implementing an integrated policy package, it is necessary to consider the interdependence between the actions and their users in supporting an effective and sustainable transportation system.

Implementing an integrated passenger transportation system requires organizational changes, so it is necessary to study the demand for transportation service users so that transportation offers can be aligned with public transportation organizations (Altshuler, 2020). The integration of urban areas faces significant challenges in urbanization, automatic connectivity of land and air transportation, new demands in transportation and logistics services, more complex traffic maintenance and infrastructure needs, and essential information digitization programs to be developed even with limited resources.

An integrated model was developed to assess the consequences of attribute and economic changes in the transportation system. The need to integrate transportation systems that operate independently can improve service quality (Winston, 2020). Changes in travel patterns should be considered to improve transportation services and lead to the design process of future transportation

systems, along with technological developments that present opportunities and challenges for urban transportation system planning. It is also necessary to develop a transportation and inventory integration model that aims to combine transportation and inventory decisions to minimize financing through the formation of different patterns covering routes, lot sizes, and the selection of developed transportation policies. The Jak Lingko transportation integration program implemented in Jakarta aims to improve the public transportation system that involves several types of mass transportation, such as rapid mass transit, light rail transit, electric trains, and Transjakarta buses, with the hope that people will be interested and switch modes of transportation using public transportation congestion and pollution are worrying (Young et al., 2020).

2. Meta-Analysis

Meta-analysis is a standard technique applied to aggregate study results individually and provide estimates of the overall effect produced and can lead to reporting significant results (Button, 2019; Van Laer et al., 2019). The eye-analysis of its application begins by dividing it into several domains or groups according to the number assessed and the scale used, which aims to evaluate the results (Lan et al., 2020). Meta-analysis was used to bridge the existing gap in the literature regarding the interrelationship of the use of variables and identify possible effects on the quality of the results obtained. A systematic approach to applying meta-analysis is carried out by identifying the main concepts, theories, sources, and knowledge gaps that can be developed through the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) pattern.

Meta-analysis is one of the analytical techniques to summarize the findings of two or more studies to combine, review and summarize previous research that can be done by investigating various questions based on the data found and published and the need for an assessment of the results of similar study. Wisniewski et al., 2020. Some of the advantages of meta-analysis research include relatively little subjectivity and judgment compared to the use of other methods, the results obtained can be more representative by using a quantitative approach, allowing a combination of research results with previous research, and more focus on the accumulation of impact so that it can produce significant results, be able to answer gaps in results that occur from various studies, and can create good organizational behavior in the business field (Gurevitch et al., 2018).

C. METHOD

This study applies a qualitative approach that utilizes scientific evolution to various scientific journal publications on the concept of an integrated transportation system. Data analysis of scientific journals was developed through scientific development with a meta-analysis approach to obtain knowledge mapping. Bibliometric analysis is implemented in a meta-analysis approach followed by applying relevant procedures in analyzing the concept of an integrated

transportation system for the development of knowledge and technology. The analytical technique in this research is a bibliometric analysis by developing the VOSviewer program based on the concept of an integrated transportation system under study. The initial step is to collect databases from various sources of scientific journals so that multiple journals that are relevant to the proposed theme are obtained. The next step is to utilize the VOSviewer program, which operates the data sources obtained from the previous process. VOSviewer can be used for the analysis of data search results. The type of data in this study is secondary data obtained through scientific searches utilizing a database of various scientific journals found on Google Scholar, with the publication period of scientific journals received in the database between 1948–2021.

D. RESULT AND DISCUSSION

1. Research Result

Transportation is one of the problems that often occur in urban areas, where the main problem is traffic jams. The issue of traffic congestion harms several transportation costs, wastes time and energy, and has social and environmental impacts. In the long term, this transportation problem will decrease the city's economic competitiveness and the city's livability for the lives of its residents.

Based on the results of the analysis, there are many articles that specifically discuss the reciprocal relationship between spatial planning and transportation, there are several links which can be briefly explained as follows: a) Spatial planning policies and their interactions with market mechanisms are determinants of the location of production activities space, distribution, and consumption that cause differences in the social and economic characteristics of each region/zone in a region; b) The spatial distribution of these activities in space will require/generate a spatial pattern of activity interactions within the transportation system which results in a pattern of movement of passengers and goods; c) Distribution of the transportation network in accordance with the existing structure (hierarchy, capacity, service) in order to create a level of spatial connectivity between locations (which can be assessed as the level of accessibility) that differs according to the capabilities of the available transportation network; d) The capability of the transportation network to accommodate travel needs between locations will result in quantitative and qualitative performance of the transportation network in terms of cost and travel time, comfort, safety, and security; and e) The distribution of accessibility in the space along with the resulting transportation performance indicators will determine the selection of locations that result in changes in the spatial system. \

Based on the analysis results of documents related to the integrated transport system, there is a positive trend from year to year. These results can be seen through the data in the following figure:

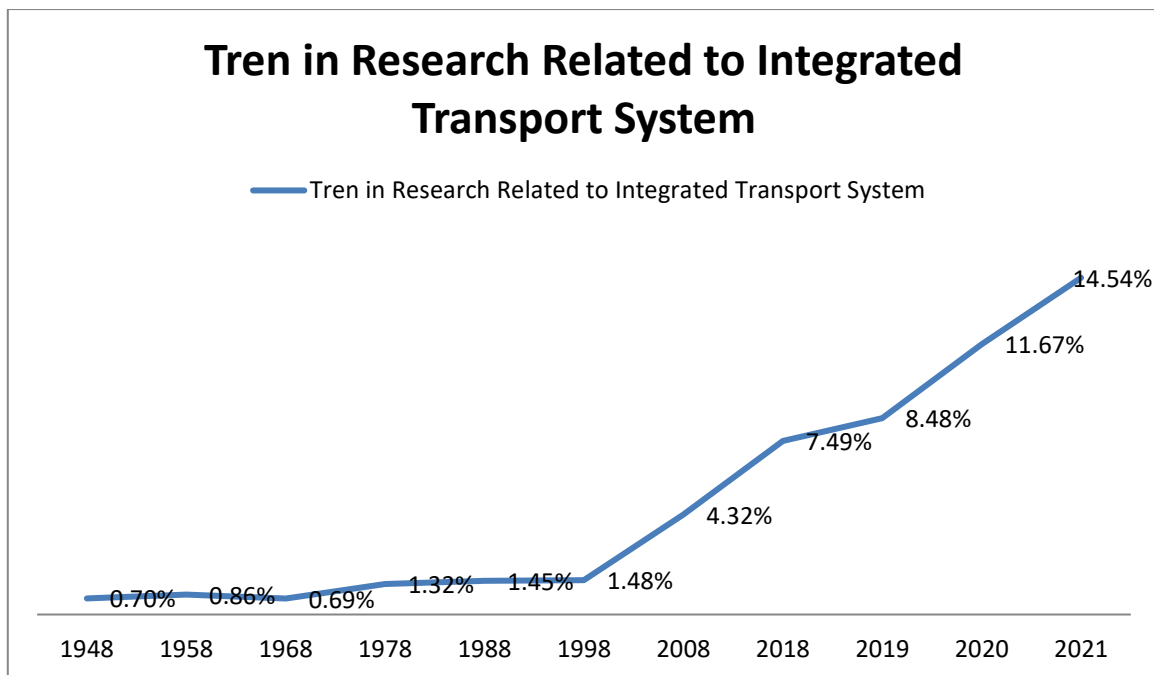


Figure 1. Trends in research related to Integrated Transport System

Source: Data Proceed

Based on these data, there are more than 1570 articles related to the discussion of the int transport system, among them the article written by Stephen Potter and Martin J Skinner entitled 'On Transport Integration: A Contribution to Better Understanding,' which has been quoted more than 145 times.

In the context of Indonesia, there are many problems in the transportation system, so this will have a broad impact on the smoothness of traffic and will ultimately hinder and harm the community's economic activities. Efforts to achieve community welfare will also be hampered. For example, many entrepreneurs and the wider community complain that the financial and business routes are always jammed in the business and economic sectors, thus increasing the cost of their expenses and work activities. This means that transportation is the dominant sector in developing the financial sector. Transportation is not only a matter of safety and comfort but also the rights of the community need to be fulfilled. Without the fulfillment of these needs, many related sectors become constrained.

Thus, it needs to be balanced with the speed of transportation facilities (modes) and infrastructure. Generally, the problem arises when the model chosen by the community is a private vehicle. The situation becomes even more complicated when the growth of personal vehicles is not proportional to the increase in the length of the existing road. This is the background for policymakers to begin to suppress the use of private cars and improve public transportation facilities and infrastructure that are more adequate.

So, it can be seen that there was a significant increase between 1998-2008 by 2.84%. Overcoming various transportation problems can only be achieved through an intermodal and integrated public transportation system (multimodal). This means

that multiple modes can be combined properly, efficiently, and effectively so that people can move from one type of transportation to another quickly, cheaply, safely, and comfortably. Thus, the formulation of transportation policy should be a comprehensive action, which must pay attention to aspects of urban spatial planning, environmental protection, public order, and enforcement of the rule of law. Formulating transportation policies that do not pay attention to social aspects of society can lead to unnecessary conflicts and tend to be counter-productive. The following are some articles related to the integrated transportation system that have the most citations, presented in the following table:

Table 1. Articles with the Most Citations

Cites	Authors	Title	Year
78	Miaojia Lu	Improving the sustainability of integrated transportation system with bike-sharing	2018
118	Fusun Ulengin	An integrated transportation decision support system for transportation policy decision	2007
261	Wendy Qu et al.	An integrated inventory-transportation system with a modified periodic policy for multiple products	1999
71	Kai Hou	A reliability assessment approach for integrated transportation and electrical power system	2016
50	Fanxin Meng	The energy efficiency of the urban transportation system in Xiamen	2017
20	Alyssa Mosca	Integrated transportation-inventory models: A review	2019
41	Szymon Fierek	Planning of an integrated urban transportation system based on macro simulation and MCDM/A methods	2012
56	Jingwei Xiong	Investigate the impact of PEV charging facilities on the integrated electric distribution systems and electrified transportation system	2015
27	Zhi-Chun Li	An integrated design of sustainable land use and transportation system with uncertainly in future population	2014

Source: Data Proceed

Many of these articles refer to the transportation system in urban areas. In general, transportation studies focus on the transportation network, location, structure, flow, and the significance and influence of the network on economic space-related to regional development with the principle of dependence between the web and financial freedom and changes in inaccessibility. In this case, the better a transportation network, the better the accessibility, so economic activities are also growing.

But in essence, a transportation system that is very good for one city is not necessarily suitable for implementation in another town. The suitability of applying a transportation system must consider all existing factors. Therefore no transportation system can be used with the same level of success in all places. In addition, the triangulation results show that Jakarta also needs an intermodal transportation system and an integrated public transportation system (multimodal). This means that various modes can be combined properly, effectively, and efficiently so that people can move from one type of transportation to another quickly, cheaply, and comfortably. Thus, implementing this land transportation system policy must also consider supporting infrastructure. The performance of transportation policies without careful planning related to supporting infrastructure will fully enforce these policies. The distribution of publications related to this matter is presented in the following figure 2 below:

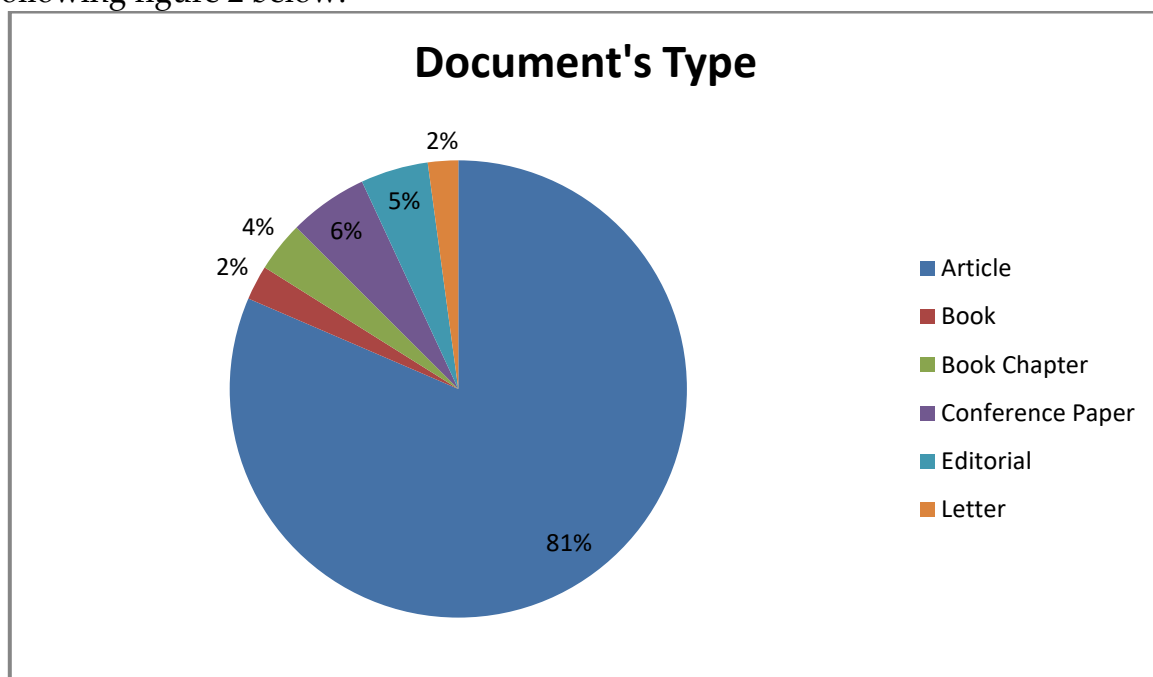


Figure 2. Documents' Type

Source: Data Proceed

Several keywords have become the core of this field of study, including Policy Implementation, Social Welfare, Sustainable Transportation, Public Participation, Planning, and Development. This is, of course, a result of the demands for high mobility in metropolitan areas in various countries that are not balanced with good transportation system services with the concept of sustainable transportation, causing transportation in these urban areas to cause negative externalities such as inefficient, uneven and environmentally unfriendly. Phenomena that arise related to this imbalance include the tendency to increase the number of private vehicle ownership and trips that are not matched by the growth of road network infrastructure resulting in congestion (congestion), delays, waste of energy and costs, as well as air and sound pollution (noise). In addition, public transportation is inadequate and far from efficient because it still has a low capacity, resulting in

wasting costs and excessive energy resources. The existence of mass public transportation is essential for the scale of a metropolitan area with high population mobility.

2. Discussion

A citation matrix used in this study attempts to answer some of the questions posed in the trend of publications related to the integrated transportation system. Several keywords are prevalent in 1948-2021, namely Policy Implementation, Social Welfare, Sustainable Transportation, Public Participation, Planning, and Development.

The phenomena that occur in the transportation aspect without any intervention in the form of software (software/policies) or hardware (hardware/infrastructure and facilities) from the government or metropolitan area management agencies will hamper the dynamics of a metro area as a center of growth. Therefore, it is necessary to carry out an intervention to direct the development of transportation towards the concept of sustainable transportation. However, there has been no empirical study of the differences in the sustainability of transportation in this metropolitan area in Indonesia which has become an input in planning a transportation system that leads to the concept of sustainable transportation.

The article with the highest citations was written by Wendy Qu et al. (1999) and instead discussed the government's policies related to transportation itself. So, suppose the formulation of transportation policies in various big cities is only intended to overcome traffic congestion. It can be considered a reactive policy because it is only taken as a reaction to the emergence of specific problems (i.e., traffic congestion). Because of that, a problem can be solved, but a new problem arises (implementation level) whose impact is more severe and complex. However, suppose the transportation policy is formulated in addition to solving traffic congestion and providing convenience to the community in traveling, enforcing spatial planning laws, reducing environmental pollution, improving people's welfare, and so on. In that case, the formulation of the policy is not something reactive but rather anticipatory.

Many things must be considered in the relationship between the implementation of land transportation system policies in Jakarta and the social welfare of the community, for example, problems of education, health, income level, needs for clothing and housing, as well as orderly living in the community environment, are factors that are pretty decisive towards welfare. By creating a prosperous state in a society, the community will feel inner and outer peace. Thus, in essence, the community's social welfare is a description of all aspects contained in the life of the community.

This policy should be structured. This structure includes job design (the process by which organizational leaders specify each job's content, methods, and relationships to meet corporate and individual demands). In this regard, it is argued

that from a legal sociology perspective, two options can be chosen to formulate transportation system policies. First, the procedure is developed according to the level of legal awareness and the community's real needs today. Second, by carrying out social engineering, which is aimed at directing changes in mental attitudes, understanding, and conditions of the community in a transportation system which, according to the opinion of the government (central and regional), is considered as something good, necessary, and following the times.

The observation results show that public policy formulation in traffic is the core of public policy because here, the boundaries of the procedure itself are formulated. Public policy in traffic is intended to intervene in public life. In contrast, the study of policy implementation in traffic is an evaluative analysis resulting from retrospective rather than prospecting. The evaluation attempts to identify the extent to which the effects originally planned to be achieved by the land transportation system policy have been realized and the impacts (predicted or previously unanticipated) caused by them.

Furthermore, the article with the most citations relates to the issue of sustainable transportation as a long-term measure of an integrated transportation system. Sustainable transport can be understood as a transportation system in which fuel, vehicle emissions, safety levels, congestion, and social and economic access will not cause adverse impacts that future generations cannot anticipate.

Sustainable transportation reflects the concept of sustainable development in the transportation sector. Several factors trigger the need for a sustainable transportation strategy in the development of the transportation system, namely: a) So far, government policies are still oriented toward developing road networks that are pro-private automobiles; b) Lack of comprehensive transportation studies; c) Rapid growth in the era of the global economy demands more diverse transportation services both in quality and quantity, and e) Concerns about threatening environmental quality degradation.

The article with this trend discusses and discusses sustainable transportation in three aspects: a) Environment. This vehicle does not endanger public health and ecosystems and provides a means of mobility by utilizing renewable resources or transportation that does not cause water pollution, air, and land and avoid excessive use of resources; b) Economy, transportation that can guarantee the fulfillment of transportation costs through the imposition of appropriate fees for the community using transportation facilities and can realize justice in the transportation system; and c) Social, transportation that can minimize noise levels, accidents, travel time losses due to congestion, and can improve.

E. CONCLUSION

Based on the results of the analysis by developing the VOSviewer program based on the concept of an integrated transportation system, articles related to the integrated transportation system from 1948 to 2021, it can be concluded that several keywords become the core of this field of study, including Policy Implementation,

Social Welfare, Sustainable Transport, Public Participation, Planning, Development. Thus, this keyword can be a reference for the development of further transportation research, development, and discussion should be centered on discussing policy implementation, sustainability, and public participation.

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