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ECONOMIC GROWTH AND TRANSPORTATION DEVELOPMENT: A LITERATURE REVIEW

Nidhi Sareen, S
Senior Research Fellow, University Institute of Applied Management Sciences,
Punjab University, Chandigarh
Email: nidhi.sareen9@gmail.com

Monika Aggarwal
Professor, University Institute of Applied Management Sciences, Punjab University, Chandigarh
Email: monikaa@pu.ac.in

Abstract

Transport infrastructure contributes to overall economic returns by stimulating mobility, accessibility, employability, and productivity. This paper endeavors to explore the domain by using bibliometric analysis. For this, the present study analyses 856 documents published in the Web of Science database during the last 31 years starting from 1989 to 2020 using VOS viewer Software. The investigation reveals an inconsistent growth in the research work over the years. Transport policy leads the journals with maximum publications. Keyword analysis identified four clusters with different themes. The analysis shows the influence of study by Easterly & Rebelo which received maximum citation. Then relatedness between publications is identified using co-citation analysis in the field. Further, the collaboration network identified four clusters where countries are collaborating. Thus, the study provides a general comprehensive view of the leading trends in the domain over past years.

Keywords: Bibliometric analysis, Citation Analysis, Economic growth, Transport infrastructure, Literature review.

INTRODUCTION

Role of transportation is vital in the development of a nation (Phang, 2003; Pradhan & Bagchi, 2013; Farhadi, 2015; Vlahinić Lenz et al., 2018). In India, transportation has been recognized as critical infrastructure for economic growth (Raghuram & Babu, 2001). Indeed, its benefits and relevance to the economy (Phang, 2003), society and the environment (Sun & Cui, 2018) is long established. The rapidly growing population with increasing economic levels demands a highly competitive transportation system. The population over the years has increased from 11.4% (1901) to 31.16% in 2011, which is expected to reach 38.6% by 2036 (Verma et al., 2021). The evolution of transport sector may roughly be split into pre- independence and post-independence era. Bicycles, steam engines, rail, and trams were the most common modes of transportation prior to the independence. Cars have become the preferred form of transportation for country's wealthy people since independence. The evolving transport sector contributes to 6.5% in the gross domestic product (GDP) of India (Verma et al., 2021). A well- oiled transportation system boosts mobilization and enhances the productivity. Support for this assertion is simple and there are a variety of ways to explain it. Firstly, transport as an unpaid factor enter as a direct input to production process. Secondly improvement in functional linkages facilitates the movement of goods in less time and reduces the cost of production process (Kim et al., 2004). According to Kim et al. (2004) in long run the change in investment expenditure changes the aggregate demand as construction of transport infrastructure increase the demand for intermediate inputs and generate multiplier effects in the economy. This is truism that volume of trade flows and growth are sensitive to technological improvements and innovations featuring a decline in transport cost. Hence, the state of art innovation in transportation infrastructure holds the potential to amplify the economic performance to unprecedented levels. The demand of transportation infrastructure is likely to grow further with economic growth, population growth and urbanization (Gramlich, 1994; Ramanathan & Parikh, 1999).

In order to perform a review, the researchers conducted bibliometric analysis of existing literature. Bibliometric analysis technique is employed to evaluate, quantify and visually present the patterns of published literature in a specific research domain (Garfield, 1970). It sheds light on the nature and course of development of scholarly work. Moreover, it succinctly and comprehensively articulates the understanding and delineates the areas for furtherance in the field of endeavor (Derudder et al., 2019). Bibliometric analysis technique has been implemented in diverse disciplines such as sustainable manufacturing (Bhatt et al., 2020), solar cells (Sabour et al., 2020), urban expansion (Xie et al., 2020), ecosystem services (Zhang et al., 2019), rural depopulation (Rodríguez-Soler et al., 2020), rural entrepreneurship (Aggarwal & Johal, 2021), economic research (Wang et al., 2020), green finance (Zhang et al., 2019), solar cooling technology (Saikia et al., 2020), green supply chain management (Maditati et al., 2018). The spatial representation of fields, specialists, document or author (Small, 1999) has been done using different software like Citespace (Gou et al., 2020), VOSviewer (Zhang et al., 2019),

HistCite (Maditati et al., 2018), Refviz (Wang et al., 2020), Gephi (Fonteyn et al., 2020), SciMAt (Bhatt et al., 2020) and Bibliometrix (Saikia et al., 2020). Thus, applying bibliometric analysis presents an unbiased and visual approach o examine the intellectual structure of specific research field. To investigate the nexus between transportation development and economic growth, the present study used four step process for reporting the findings. Firstly, the keywords were delineated, then initial search was done followed by conducting descriptive and bibliometric analysis. Total documents generated counted to 1154 out of which 27 were processed that were analyzed using VOSviewer software.

The present research topic draws attention from a wider spectrum including academia, educators and research institutions. This work is first endeavor that identifies the intellectual structure of the field. Thus, this study contributes to the multidisciplinary and growing body of research on transport sector by portraying the dynamics between various foci of the field. Through this way , researchers can enhance their knowledge regarding research gaps, research frontiers and potential topics. Related research findings can be considered by policymaking institutions, research centers and institutions studying the impact of transportation sector on the economy. The network analyses helps to promote collaborations for institutions in first world and third world countries.

LITERATURE REVIEW

Over the years, numerous research studies had focused on the theoretical and empirical investigation of the macroeconomic models that establishes the relationship between transportation and economic growth. Vlahinić lenz et al. (2018) acknowledge the pertinent role that transport system play in boosting the growth in Central and Eastern European Member States economies. In MENA (Middle East and North Africa countries), Samir et al. (2018) illustrated a favorable contribution of transport infrastructure in all the regions. Similarly, Ng et al. (2017) found improvement in transport mobility facilitating growth in countries having medium and high level of development.

Wang & Zhang (2020) found that for every 1 percent increase in level of transportation, employment density is increased by 0.1274 percent. Further road infrastructure promoted the employment of service industry more than railways and inland waterways. Vasiliene- vasiliauskiene et al. (2019) found the direct effect of transportation system on housing markets and suggested that prudently investing in transportation system indirectly improved the quality of life of the residents. Ali et al. (2018) highlighted benefits of transport project by investigating the environmental, cultural, economic and social consequences of road and transportation on local residents by examining their attitude towards the development of China Pakistan Economic Corridor (CPEC). Studies including Chi & Baek (2013), Jiao et al. (2020) and Liang et al. (2020) have duly testified the catalyzing of development by the transport infrastructure across the literature.

The above review of literature shows that the existing literature including Vlahinić lenz et al. (2018), Samir et al. (2018), Ng et al. (2017), Wang & Zhang (2020), Vasiliene- vasiliauskiene et al. (2019), Ali et al. (2018), Chi & Baek (2013), Jiao et al. (2020) and Liang et al. (2020) have focused more on macro-economic models and has associated the variables with the economic growth. Moreover, these studies have focused on different countries. None of the studies reviewed so far has identified the grey areas for future research on the basis of extensive literature review. The existing literature since 1989 to 2020 has not been analyzed using bibiliomeric analysis. The present study endeavors to fulfil this gap by focusing on analyzing literature review. To the best of our knowledge, this is the first study that makes an attempt to comprehensively explore the interlinkages between transport and economic growth using bibliometrics. The aim of this study is to investigate the entire research domain and uncover important paradigms like influential authors, journals, institutions and countries, as well as the networks that connect them.

OBJECTIVES

This article intends to investigate the following research questions (RQs):

(RQ1): What is the global trend of scientific publications studying the nexus between transportation development and economic growth?

(RQ2): Which are the leading journals publishing documents in the domain of transportation development and economic growth?

(RQ3): What are the main research fields based on the co-occurrence keywords investigated in the past?

(RQ4): Which are the most cited publications that have contributed significantly?

(RQ5): What is the co-citation network of references in the literature?

(RQ6): Which countries collaborate most in studying the transportation development –economic growth literat ure?

RESEARCH METHODOLOGY

Authors adopted a 4-step process to assess the trends of publication for the chosen topic.

Delineating keywords

In order to provide a comprehensive perspective, the research articles were browsed using the topic criteria: TS = ((“ Transport” OR “Transport Infrastructure” OR “ Transportation development” OR “ Road Infrastructure” OR “Air Transport” OR “ Aviation Infrastructure” OR “Railway Infrastructure” OR “ Port Infrastructure” OR “ Urban Public Transport”) AND (“ Economic Growth”)).

Primary and Refined Search Results

Web-of-Science (WoS), Scopus and Science Direct are the different online databases that can be used to conduct bibliometric literature reviews. The author collected data from

the WoS database since it includes the greatest pool of papers and related citations for obtaining global academic information of disciplines (Wang et al., 2020; Zhang et al., 2019; Maditati et al., 2018; Jiang et al., 2020; Xie et al., 2020). SCI-E, SSCI and A&HCI citation database forms part of the core collection of WoS. Data extracted from Web of Science database included 1,154 articles all written and in-press articles from the year 1989 to 2020, except books, book chapters, and conference articles. Table 1 shows the concentration of publications based on chosen and coupled keywords.

Table 1: Initial search and refined results

Keywords	Primary Result (No. of articles)	Refined Results (No. of articles) *
Transportation infrastructure and Economic Growth	1154	27

*Filters; Language – English; Source- Journals; Web of Science Categories ((Business, Business Finance, Economics, Transportation, Management, Transportation Science Technology, Social Science Interdisciplinary, Regional Urban Planning and Urban Studies).
Source: Web of Science; 1989 to 2020 and Author's Own Compilation.

These articles cover author details, article title, publication year, source, affiliation, and abstract. After applying filters, the primary results yield a total of 96 research contributions. The reason for using the above-mentioned filters is that this article intends to review the relationship between economic growth and transportation. Further, papers without open access were excluded, reducing the count to 27 articles that were downloaded in the readable format and were analysed using VOSviewer software.

DATA ANALYSIS AND INTERPRETATION

A. Descriptive Statistics: Distribution of publications: In this subsection, Table 2 shows the yearly record of the number of publications in the domain of transportation development and economic growth. The first record was published in 1993, and then with gap another publication was done in the year 2005 after which there was 1 publication per year. Beginning 2013 a rise in the publication is witnessed. It is evident clearly from the output in Table 2 that research publication have mostly seen a progressive trend. The increase in publication has always covered the fall, particularly 2014, 2018 and 2020 showed a significant increase in contribution in the field. Year 2020 has spotted five publications till July. The research domain is gradually receiving the attention of researchers and academicians all over the world.

Table2. Distribution of publication over the years

Publication Years	Records	Publication Years	Records
2020	4	2012	1
2019	2	2011	1
2018	4	2008	1
2017	3	2006	1
2015	2	2005	1
2014	4	1993	1
2013	2		

Leading Journals

Table 3 displays the ten leading sources on transportation development and economic growth. The leading journals are the Transport Policy with 18.52% of the cumulative publications, Transportation Research Part a Policy and Practice with 18.52% of the total publication, Economic Research Ekonomska Istrazivanja, European Journal of Transport and Infrastructure Research and Revista De Historia Economica with 7.41% cumulative publication by each. Moreover, Journal of Monetary Economics with 745 global citation and Transport policy with 552 citations were the leading sources with maximum number of global citations per journal published in the domain.

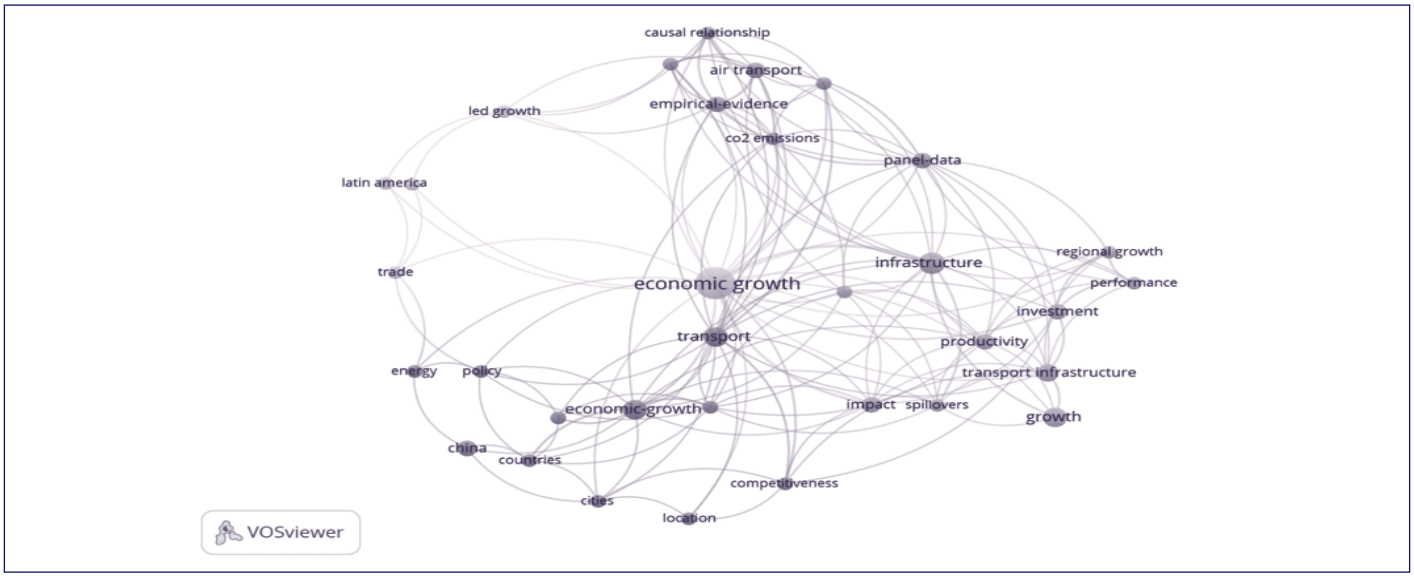
Table 3. Leading Journals

R	Journal	TP
1.	Transport Policy	5
2.	Transportation Research Part a Policy and Practice	5
3.	Economic Research Ekonomska Istrazivanja	2
4.	European Journal of Transport and Infrastructure Research	2
5.	Revista De Historia Economica	2
6.	Amfiteatru Economic	1
7.	Energy Policy	1
8.	Inzinerine Ekonomika Engineering Economics	1
9.	Journal of Development Studies	1
10.	Journal of Economic History	1

Source: Own elaborations. R: ranking; TP: Total publication

B. Bibliometric Analysis: Analysis of keywords: Co-occurrence analysis is conducted to identify the most common keywords. The unit of analysis in focus is on all the keywords to illustrate the main areas in the discipline. Figure 1 shows the keywords and nodes. The VOS viewer confirmed the presence of 216 keywords in 27 publications on impact of transportation development on economic growth. The keyword having maximum occurrence is shown in bolder node. The closeness between the nodes reflects higher association between the two words. The lines connecting the nodes shows co-existence. Of the total 216 keywords 33 meet the threshold of the minimum 2 number of occurrences.

Figure 1. Co- occurrence Analysis



The keywords are grouped into 4 cluster of similar colour nodes as shown in the figure 1. The first cluster in red contains 11 keywords; economic- growth, transport and cities are top three prominent keywords. The next cluster in green contains 10 keywords; the leading 2 keyword of second cluster (green) are infrastructure and growth. Air transport, empirical evidence and panel data are three leading keywords in third cluster in blue represented by 7 keywords in total. Finally, the yellow, the fourth cluster, contains 5 keywords; economic growth, Latin America and led growth are the prominent keywords in this cluster. Most cited articles in transportation development and economic growth: The number of citations is analyzed to evaluate the different documents published with focus on transportation development and economic growth. The top ten papers with most citations are ranked in order to find the essential documents in the discipline. The analysis shows the quality and influence of documents (Liao et. al., 2018). Table 4 reveals ten most widely cited articles in transportation development and economic growth. As can be shown from table the most cited paper is by Easterly & Rebelo (1993) with 745 citations in the Web of Science. This article is an empirical investigation of fiscal policy and economic growth. The findings revealed a correlation between investment in transport and growth. The second most frequently cited article in paper is by Tapio (2005) with 446 citations. The paper discusses the relationship in gross domestic product, traffic volumes and CO2 emissions in the European Union. The findings showed expansive coupling regarding passenger transport and expansive negative decoupling regarding freight transport. Further, the third most cited article in paper is by Melo et al. (2013) with 109 citations. The article frames the results from the model indicate higher output elasticizes in long run than short- run and medium -run, which suggests that maximum scope for economic effects of transport sector in longer term.

Table 4. Leading cited Articles

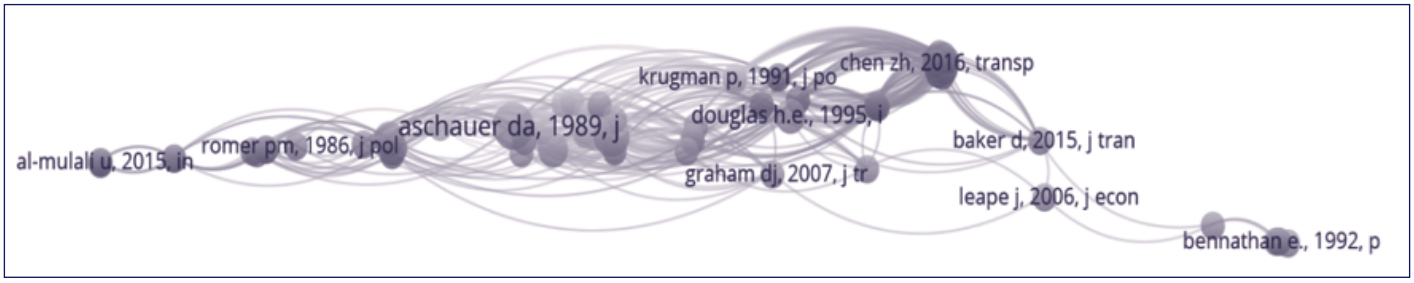
R	Article	TC	Author (Year)
1.	Fiscal-Policy and Economic-Growth - An Empirical-Investigation	745	Easterly & Rebelo (1993)
2.	Towards a theory of decoupling: degrees of decoupling in the EU and the case of road traffic in Finland between 1970 and 2001	446	Tapio (2005)
3.	The productivity of transport infrastructure investment: A meta-analysis of empirical evidence	109	Melo et al. (2013)
4.	Infrastructure and regional growth in the European Union	106	Crescenzi & Rodriguez-Pose (2012)
5.	Dynamic relationship between air transport demand and economic growth in the United States: A new look	45	Chi & Baek (2013)
6.	The impact of the economic crisis and policy actions on GHG emissions from road transport in Spain	37	Sobrino & Monzon (2014)
7.	The long-run relationships between transport energy consumption, transport infrastructure, and economic growth in MENA countries	33	Saidi et al. (2018)
8.	Road freight transport decoupling: A comparative analysis between the United Kingdom and Spain	29	Alises et al. (2014)
9.	Beyond 'predict and provide': UK transport, the growth paradigm and climate change	28	Goulden et al. (2014)
10.	Railroad impact in backward economies: Spain, 1850-1913	25	Herranz-Loncan (2006)

Source: Own elaboration based on the WOS, R: Ranking; TC: Total Citations

Co- Citation analysis: Co-citation analysis is utilized to appraise the relatedness between two publications. In simpler words, citing two studies jointly by another study is termed as co-cited (Sharma et al., 2018). This reflects the similarity of thoughts and belongingness to same research cluster. More co citations appear in documents the higher assumed relatedness they have (Shiau et al., 2017). The technique is employed to determine an articles academic affiliation and map the intellectual structure of specific research area (Calabretta et al., 2011). As citations grow over time, Co citation analysis presents the coherence and adaptations in the literature in terms of article and book, oeuvres, or journals (White & McCain, 1998). In the present study, the publication in Web of science database is analyzed for in depth overview of cited references co-citation networks. Figure 2 node represents a reference, and its size connotes the total number of citations these references have received. The link between two nodes denotes a co-citation relationship, and the bolder the ring is, more firm is the strength of the relationship. The locus of the nodes and shades clusters the items, and there are three clusters denoted by different shades.

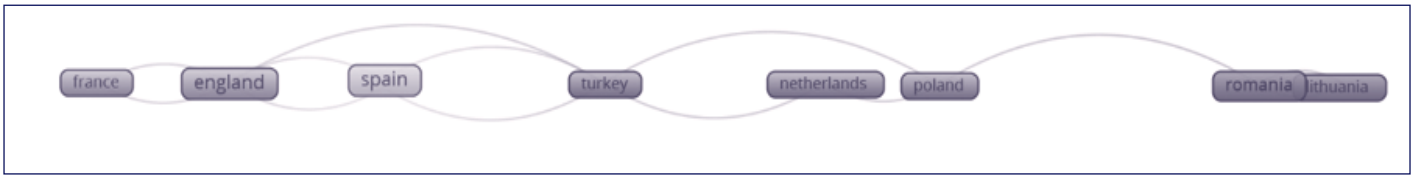
Co- Citation References: As per Lin and Himelbolm (2019) reference co citation network enables to find most influential scholars in a knowledge area. These scholars contribute to knowledge diffusion in their research field. The leading documents nodes specifies the first author, year and journal. Figure 2 show the cluster analysis of 27 publication related to transport development and economic growth arranged into 5 cluster. The first cluster in red contains 16 items. In this the most cited work was of Chen (2016), with 2 Citations and total link strength of 29. Aschauer (1989), led the second cluster in green having 14 items and is overall was one in the ranking with 5 citations and 41 total link strengths. Crescenzi (2012), the second most cited document with 4 citations and total link strengths of 36, is also the second leading in this cluster. Pradhan & Bagchi (2013) led the third cluster in blue having 14 items with 3 citations and 21 link strength. The fourth cluster in the yellow color contains 11 items and Evans & Karras (1994) tops the list with 3 citations and 35 link strength. Finally, the purple cluster having 9 items is led by Baker et al. (2015) with 2 citations and 17 link strength. The diagram reveals valuable insights to know the most impactful scholars in Transportation research. The leading references by Rudra and Bagchi (2013) found a bidirectional causality between road transportation and economic growth, Evans & Karras (1994) studied if government activities are productive and found government educational services as productive. Baker et al. (2015) found causality between regional aviation and economic growth while Crescenzi 2012 found infrastructure endowments as poor predictor of economic growth. Thus, the co-citation references helps in identifying the most impactful authors including Aschauer (1989), Crescenzi (2012), Pradhan & Bagchi (2013) Evans & Karras (1994) and Baker et al. (2015) in their respective clusters and explored the subjects and themes they have been working on. The authors have studied the causal linkages for different sector like road, aviation and educational services.

Figure 2: Co- Citation References



Co Authorship –Countries: Figure 3 presents the output of collaborative network that exist between the countries. The threshold limit of documents and citations for Co Authorship analysis of countries is set at 1 and 1 respectively. 19 countries qualified the criteria and are grouped in 4 cluster (fig: 3). The red cluster has 3 countries; Romania with 3 publication 34 citation and 3 link strength, Czech Republic with 1 publication, 9 citation and Lithuania with 1 publication and 9 citations. Cluster 2 in green shows collaborative network between 3 countries; England (7 documents and 293 citation) France (with 1 publication and 33 citation) and Tunisia (1 publication and 33 citation) cluster 3 in blue shows collaborative network amongst Poland (with 2 publication and 26 citation), Turkey (2 publication and 4 citation) and Netherlands (1 publication and 3 citation). Finally, Cluster 4 in yellow has Spain with 6 publication and 104 citation) and Russia with 1 publication and 1 citation.

Figure 3: Co authorship- Countries



DISCUSSION AND CONCLUSION

This study seeks to offer a bibliometric analysis of the evolution of literature analyzing the nexus between transportation infrastructure and economic growth in Web of Science indexed journals from 1989 to 2020, a period spanning 31 years. The extensive literature review intends to add significant value to the available literature. Firstly, in last thirty-one years there has been an inconsistent growth in the contribution of publication in the field. Secondly, leading journals like Transport Policy, Transportation Research Part a Policy and Practice, Economic Research Ekonomska Istrazivanja, European Journal of Transport and Infrastructure Research and Revista De Historia Economica, had published 77.78% of total cumulative documents in the field of transportation development and economic growth. Thirdly, Co- occurrence analysis delineated the developments in scientific field into four clusters. Different clusters are highlighting different themes where the first cluster shows how the concept is being studied at city level by researchers, which will become a guiding point for improving the transport infrastructure at local level so that local economy is boosted. Cluster 2 identifies the importance of concept for all of the infrastructural facilities. The next cluster reflects the contribution at subsector level in transport infrastructure. Finally, cluster 4 present the regional analysis of the concept that highlights the importance of connectivity in the nations in proximity. Fourthly, the current study identified the top cited papers focused on studying the relationship between investment in transport and growth (Easterly & Rebelo, 1993; Crescenzi & Rodríguez-Pose, 2012; Melo et al., 2013),GDP, Traffic volumes and CO2 emissions (Tapio, 2005), transport infrastructure and transport energy consumption on economic growth (Saidi et al., 2018) and economic growth on air transport demand (Chi & Baek, 2013).These publications had been spread evenly over the period under study. The researchers concluded presence of both positive and negative outcomes. Keeping in loop with the empirical results put forth by Easterly & Rebelo (1993), Tapio (2005), Melo et al. (2013), Chi & Baek (2013) and Saidi et al. (2018) found a positive contribution by the transport infrastructure to the economic growth. On the contrary Crescenzi & Rodríguez-Pose (2012) stated that the transport infrastructure endowments are the poor predictor of economic growth. In the work of Sobrino & Monzon (2014) the results demonstrated the contribution of growth to the increased road transportation emissions. While investigating the relationship between transport infrastructure and economic growth several recommendations were put forth. Researchers suggested studying the causality from both direction and taking in account for urbanization and congestion levels to avoid omitted variable biasness. Secondly using dynamic approach to understand and design effective policies. While others suggested encouraging policies focusing on energy efficiency strategies by nations. Some suggested countries under investigation to develop transport infrastructure and adopt new technologies. The enhancement in network will increase the connectivity and bring in more private investment. Fifthly the results from the co-citation reference analyses grouped the publication into five clusters, namely, red, green, blue, yellow and purple. Chen (2016), Aschauer (1989), Pradhan & Bagchi (2013), Evans & Karras (1994) and Baker et al. (2015) are the lead authors in their respective clusters on the basis of total link strength.

Lastly, co- authorship analysis groups the countries collaborating to study the effect of transportation infrastructure on economic growth into four clusters. Red cluster is led by Romania; the green cluster by England; blue cluster by Poland and finally yellow cluster by Spain. Conclusively this article, provides the comprehensive bibliometric overview of the literature on the nexus between transportation development and economic growth. In general, to stimulate economic growth by enhancing the transportation infrastructure is the topic of research across various nations. The findings of the study undoubtedly would provide meaningful perspectives for academicians, policymakers, and other similar groups to use for the betterment of the country. The authors share a few observations and suggestions for future investigations. The most important aspect is the introduction of longitudinal studies, as longer periods of study enable researchers and policymakers to better understand the impact of transport infrastructure on the economic growth. The underlying explanation is that everything appears to be advantageous in the short term, but the true effect, whether positive or negative, is realized in the long run. The studies had revolved around different themes. Some had studied the impact of investment in transportation and growth while other studies are giving prominence to the environmental concerns, which is being studied by examining the relationship of transport energy consumption and economic growth. Some studies had subsector level i.e. Railway and air transport as the unit of investigating the relationship.

LIMITATION AND AGENDA FOR FUTURE RESEARCH

Realistically, any research project is shadowed by certain constraints, and this study is no exception. First the study used Web of Science database that inevitably lacks coverage of all the publications. Thus, future research should supplement more in-depth analysis by considering other databases like Scopus and Google scholar. Second, regardless of how much attention is paid to the collection of keywords, it is entirely at the discretion of the researcher to finalize the criteria. Thirdly, the use of tools similar to BibExcel and Gephi, such as SciMat, for analyzing varied clusters might give varied results. Though the clusters listed in this article are extensive, there is the possibility of having even more via other similar methods. The grey areas which can be explored further are the role of transport infrastructure in regional level growth, location, performance, transport development and trade and transport policy.

IMPLICATION OF THE STUDY

The current study frames the knowledge pertaining to the evolution of literature in the domain. The present state of literature is comprehended by studying the nexus between transportation development and economic growth in terms of publication trends, top journals, commonly used keywords, most cited publications, co citation network and collaborative network amongst countries. According to research, there has been substantial development in recent years in the body of

knowledge. Overall, the literature concludes that countries should enhance the transportation infrastructure to promote economic growth.

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