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Sustainable Development and Public Transport in Haryana

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Abstract

This study examined the efficiency of public transport in Haryana from 2015-16 to 2020-21 in cognisance of the sustainable development aspect. The depots of the state roadways are considered as decision-making units. The study employed the Data Envelopment Analysis (DEA) technique for estimating the scores of the overall technical efficiency (OTE) and pure technical efficiency (PTE) of decision-making units (DMUs) by using three inputs— fleet size, total staff and bus utilisation. The study considered the total daily passengers transported and effective kilometres covered for the output. Further, along with the efficiency measurement, each depot's total number of accidents has been collected to measure safety. The findings estimated the mean value of the PTE score for all depots, which turns out to be 0.91, indicating that to improve the managerial efficiency of the entire public transport of the state, the depots need to increase the output by 9 per cent. The average OTE score of all selected units is 0.89, reflecting that these DMUs have 89 per cent worked efficiently from 2015-16 to 2020-21. The efficiency score is based on output-oriented issues, meaning that inputs will be constant for total efficiency. The study recommends the promotion of public transport based on sustainability and efficiency in the State of Haryana.

Keywords: Sustainable Development; Public Road Transport; State Transport Undertaking; Haryana Roadways; Data Envelopment Analysis; Haryana; India

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Introduction

In the current economic development climate, there has been an unmatched growth in economic activities and urbanisation. For a better standard of living in a developing nation like India, industrial and technical development is crucial (Mohapatra et al., 2023). Transport remains vital for promoting the growth of any economy. Along with the growth of an economy, the development of every sector also depends upon transport. Indeed, better infrastructure is a critical factor in promoting national integration. Nowadays, conventional transport is converted towards sustainable transport. Sustainable development focuses on how the development process should be crafted in such a way that the necessities of the current generation need to be accomplished without negotiating the wants of the upcoming generations (Greenland, 1998; Grant, 2010; Mensah, 2019). However, sustainable development is crucial for economic and social development (Szymańska, 2021). Sustainable development and public transport remain highly interlinked, bearing a deep connection between them. The primary focus of this study is to delineate the relationship between sustainability and the transport sector.

Every region faces different difficulties in attaining sustainability (Ozili, 2022). For sustainability, the government has also made many policies such as renewable energy transition, fossil fuel emission and green economy. These positively impact the environment, including climate, leading to sustainability (Aven, 2020). It is arguable that to deal with scarce resources, the concept of sustainability is developed in the field of economy. Allocation of resources is for the people and by the people (Szymańska, 2021). The key feature of sustainable development is to promote eco-friendly development, which helps minimise environmental damage and optimise the use of natural resources.

Similarly, we argue that more use of private vehicles leads to congestion and pollution. Therefore, requirements for transport should be satisfied with the deployment of public transport, which is good for the environment and leads to reduced traffic congestion and condensed pollution. In other words, we need to move towards sustainable transport. Recent research reveals that promoting automated vehicles enhances efficiency (Orsot-Dessi et al., 2023).

Sustainable transport includes safety, efficiency, minimum environmental damage, and focus on climate changes and accessibility. After India's independence, the transport sector witnessed tremendous growth. At the same time, the need for an efficient transport system in India has been realised. Given the increasing activities of transport, it can be estimated that the resources are getting reduced and on account of scarce resources future generation may suffer a lot. The transport sector is crucial to any country's social and economic development. Nevertheless, the matter of concern is that due to increasing transport activities, many problems arise like congestion, road accidents, environmental damage, climate change and pollution, etc. The transport sector plays a dual role; on the one hand, it is progressing towards development, and on the other, it is dangerous for society and the environment.

This study focuses on two objectives of sustainable transport: the safety and efficiency of public transportation in Haryana. Haryana is a progressive state, and it is a state of north India, which is only ranked 22nd in terms of area, but the road network is pretty good. Before 1st November 1, 1966, Haryana was a part of Punjab. However, after recognising Haryana as a separate state on 1st November 1966, the construction of roads and highways continued. The state public transport has notably developed in recent years and is doing much better regarding safety indicators. However, the number of staff/ employees has been reduced instead of increasing. It has a fleet of about 4250 buses operated by 24 depots (Hooda & Sehrawat, 2021).

This present endeavour comprises six sections. The next section discusses the existing literature review and the objectives of the study. The

section following this, elaborates on the research methodology and database used in this study. Then, it discusses the results and findings of the study, while the last section is devoted to the conclusion.

Literature Review

The concept of "sustainable transportation" has been used as an explicit model for transportation expansion that would benefit the environment and society (Jothilakshmy & Marudachalam, 2007). The narrow definition of sustainable transport focused on environmental issues and the depletion of resources. On the other hand, the broader meaning of sustainable transport emphasises social and economic benefits (Zhao et al., 2020).

Sustainable transport connects to safety, efficiency, minimum environmental damage and focuses on climate changes and accessibility. Considering the importance of sustainability, scholars are taking a profound interest in assessing the significance of state transport undertakings (Choudhuri, 2019). The researchers have contributed their efforts in transport, sustainability and interconnections (Aven, 2020; Buddenhagen, 1999; Grant, 2010; Ozili, 2022; Szymańska, 2021). Further, scholars have researched various issues in the field of public transportation, connecting sustainability with the energy and transport sector (Abhyankar et al., 2017; Agarwal et al., 2010; Chakrabartty & Gupta, 2015; Kharola & Tiwari, 2008; Ramanathan & Parikh, 1999; Singh, 2017).

These studies unravel that sustainability directs the usage of existing assets and resources in a better way to make sure that the resources are accessible and sufficient to cater for the current needs of the future generation. In doing so, a few studies demonstrate how the notion of sustainability can be employed to understand the capacity to make decisions for the appropriate provision of funds to economic and non-economic activities (Grant, 2010), including the various aspects of economic and non-economic activities, such as product sustainability (Dyllick & Rost, 2017; Watz & Hallstedt, 2022), urban sustainability (James et al., 2014), business sustainability (Bansal & DesJardine, 2014), career sustainability (Tordera et al., 2020) and fiscal sustainability (Byrne et al., 2011).

However, the transport sector's development remains vital for any economy's development. At the same time, the development of this sector could be staggeringly harmful to the environment. Nowadays, transport has become the primary reason for air pollution. Due to excessive usage of private vehicles, many problems occur like congestion, road accidents, environmental damage, climate change and pollution. Public transport must be developed and facilitated to address the above-mentioned issues.

Along with private vehicles, the use of public transport should be enlarged, which will prove to be good for the environment and society. This study primarily emphasises transportation and sustainability. It tries to explain how public transport leads towards sustainability. For this purpose, the two indicators necessary for sustainability are efficiency and safety. So, the key objective of this study is to examine the efficacy of state transport undertakings in Haryana and also analyse the status of safety indicators for the public transport sector at the depot level. Furthermore, this study also evaluates the targeted value for the inefficient units by exploring pure technical efficiency with the help of the Banker, Charnes and Cooper (BCC) model.

Methodology

In this study, two significant indicators, namely safety and efficiency, have been selected, which will be deployed to assess whether the public transport of the state of Haryana is sustainable. The study examined the number of accidents to study transport safety in the state of Haryana. To evaluate efficiency, fleet size, total staff and bus utilisation were taken as inputs, daily passengers carried out, and effective kilometres were considered outputs. The data for measuring the efficiency are collected from secondary sources involving official documents, reports, etc., of the state government from 2015-2020. Currently, 24 depots and 13 sub-depots are effective in the state and operated by the Department of

Haryana Roadways. The study considers only 24 depots for the efficiency estimation of the transport undertakings.

The non-parametric Data Envelopment Analysis (DEA) technique has been employed to justify this study's objectives. For this, the study followed the DEA model developed by Charnes, Cooper and Rhodes (CCR) in 1978 and Banker, Charnes and Cooper (BCC) developed in 1984 (Banker, 1984; Charnes et al., 1978). These models' critical feature is that they are applied to the homogenous units (Agarwal, 2016), and there is no need for a functional form. These models of DEA have been used to evaluate the total technical efficiency, pure technical and scale efficiency for the state transport undertakings (Aneja & Sehrawat, 2022).

Selection of Inputs and Outputs for Data Envelopment Analysis

As discussed above, DEA has been used as Decision-Making Units (DMUs) are homogenous, and results have been extracted by selecting homogenous units. The total fleet uses inputs and outputs for these DMUs. The fleet size, total staff and bus utilisation are employed as inputs, whereas daily passengers carried out and effective kilometres have been considered as outputs. The total fleet size refers to the total number of buses operated in the state that denotes its capital input. The total number of staff indicated the labour input of DMUs and fuel consumption had been taken as the material input. The fuel consumption is the ratio of the total effective kilometre and fuel average. So, the variables inputs refer to the total fleet size (capital input), total staff (labour input) and fuel consumption (material input), which have been used to estimate efficiency.

Data Envelopment Analysis

The DEA technique is essential for quantifying the efficacy score of selected decision-making units. DEA is the non-parametric method, which does not need any distribution and functional form. It is a distribution-free technique. Here, the units selected for the efficiency evaluation should be homogenous.

For efficiency evaluation:

$$\text{Max } E_k = \frac{\sum_{r=1}^{s} u_{rn} y_{rn}}{\sum_{i=1}^{m} v_{in} x_{in}}$$

The DEA models estimate n number of DMUs. For every DMUs p, different inputs have been considered for producing the q outputs. The efficiency score of each DMUs cannot be more than one. Furthermore, one essential thing is that the weights for all inputs and outputs ought to be greater than 0, that is, $\lambda_a+\lambda_b+\lambda_c+\ldots\ldots\ldots \lambda_n \geq 0$. For the model specification, homogeneous n DMUs units have been employed (DMU_j,j=1,2,3…….n).

For safety indicators, the accidents by the buses in all depots in a year are considered. Compound annual growth rate (CAGR) of the total number of accidents has been calculated during the study period. The positive growth rate is evidence of low safety in public transport. On the other hand, it reflects the negative CAGR, which indicates that the public transport in Haryana is performing well in safety measures. The accident rate should be declining over the period with better utilisation of DMUs. To reiterate, this study examined the overall technical efficiency and pure technical efficiency by using the DEA models, that is, CCR and BCC.

Results and Findings

This study has 24 decision-making units (Table 1) with different efficiency scores. Based on these efficiency scores, we examined the extent of the efficiency of the depots. Here, the efficiency measurement has been done by collecting the data for the study period. The mean value is also calculated under the CCR model. Under this model, the overall technical efficiency of the DMUs has been extracted, which means that here, inputs are assumed to be constant and inefficient units need to increase their output with the existing level of inputs. Indeed, the CCR model captures the overall efficiency of selected decision-making units, as reported in Table 1.

Table 1: Overall Technical Efficiency Scores							
DMUs	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Mean value**
Ambala	0.90	0.92	1.00	0.94	0.98	1.00	**0.96**
Bhiwani	0.95	1.00	0.88	0.86	0.90	0.84	**0.90**
Charkhi Dadri	0.79	0.88	0.84	0.81	0.86	0.83	**0.84**
Faridabad	0.80	0.78	0.86	0.62	0.79	0.77	**0.77**
Fatehabad	0.93	0.88	0.93	0.95	0.90	0.91	**0.92**
Gurugram	1.00	1.00	0.88	1.00	0.72	0.74	**0.89**
Hisar	0.95	0.91	1.00	1.00	1.00	1.00	**0.98**
Jhajjar	0.76	0.82	0.87	0.88	0.88	0.87	**0.85**
Jind	0.87	0.93	0.84	0.90	0.87	0.93	**0.89**
Kaithal	0.86	0.92	0.86	0.85	0.80	0.70	**0.83**
Karnal	0.89	0.91	0.91	0.90	0.85	0.67	**0.86**
Kurukshetra	0.93	0.96	0.95	0.88	0.96	0.86	**0.92**
Nuh	0.88	0.86	1.00	0.88	0.81	0.98	**0.90**
Panchkula	0.88	0.78	0.65	0.65	0.76	0.90	**0.77**
Palwal	0.88	0.82	0.86	0.75	0.89	0.96	**0.86**
Panipat	0.88	0.84	0.80	0.87	0.82	0.70	**0.82**
Rewari	0.88	0.89	0.93	0.94	0.92	0.83	**0.90**
Rohtak	0.90	0.88	0.95	0.99	0.96	0.87	**0.92**
Sirsa	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
Sonipat	0.87	0.88	1.00	0.94	0.85	0.69	**0.87**
Yamuna Nagar	0.89	0.90	0.90	0.85	0.82	1.00	**0.89**
Chandigarh	1.00	1.00	1.00	1.00	1.00	1.00	**1.00**
Delhi	1.00	1.00	1.00	0.96	1.00	0.90	**0.98**
Narnaul	0.91	0.95	0.95	0.92	1.00	0.95	**0.95**
Yearly mean value	0.90	0.90	0.91	0.89	0.88	0.87	**0.89**
Source: Authors' Own Calculation							

Input and output efficiency scores have been calculated to estimate the technical efficiency of public road transport in selected areas of Haryana. The range of efficiency score is 0 to 1, which indicates that the DMUs with efficiency score one worked efficiently, the inputs are fully employed, and there is no need to reduce inputs. As already discussed, Table 1 indicates the efficiency score of various DMUs from 2015 to 2020. From these efficiency scores, it is crystal clear that from 2015-20, the average efficiency score was 0.89, which shows that these DMUs worked 89 per cent efficiently and bear about 11 per cent scope for reduction in their outputs. The separate efficiency scores calculated for all the depots are close to one during the period. These DMUs were performing well from 2015 to 2020.

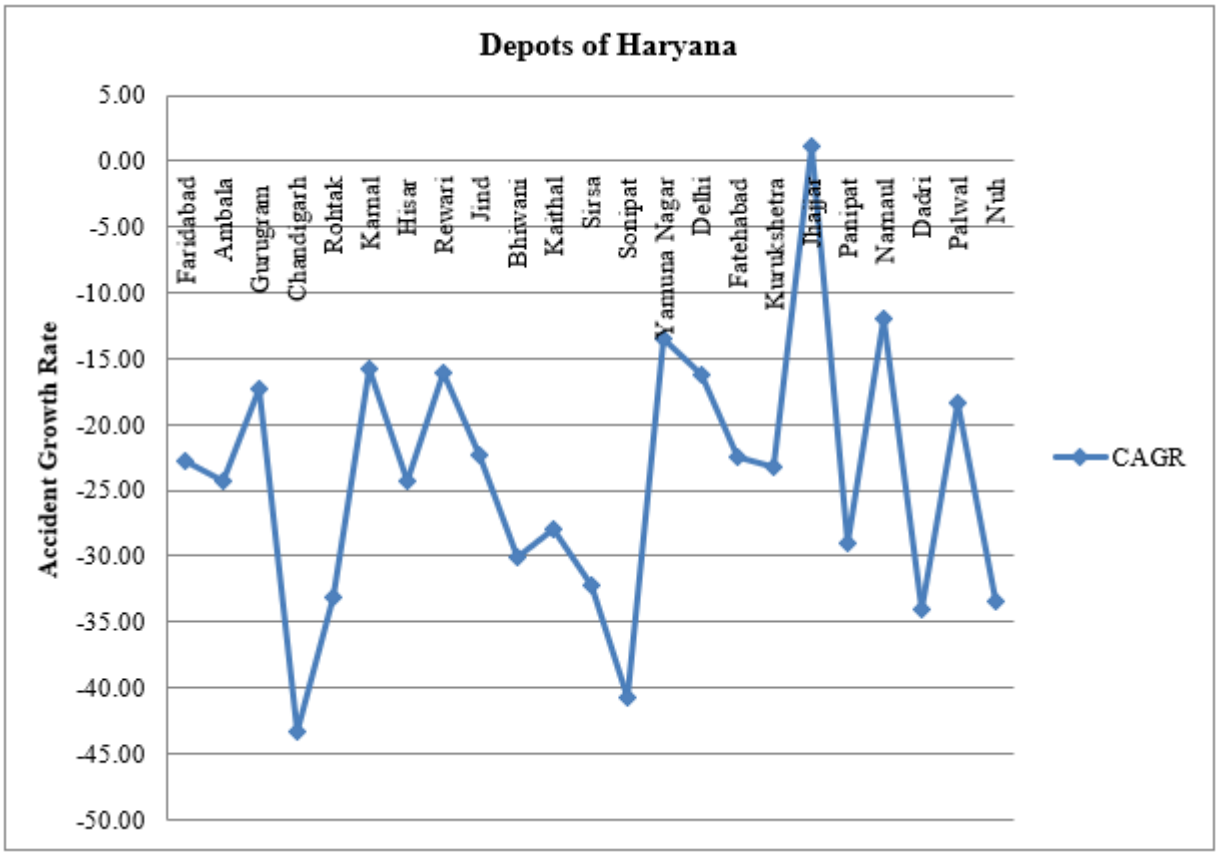
Each depot's total number of accidents has been collected to examine transport safety. For this, there are Haryana roadways which fulfil public transport needs. In Table 2, the data on accidents have been collected for all the depots. Using these data, the status of transport safety has been calculated by applying the Compound annual growth rate (CAGR). The percentage and compound annual growth rate methods have been employed to quantify the growth rate of safety indicators.

Compound annual growth rate (percentage) = [logest (Ya1+Ya2+Ya3+…….Yan)-1]*100

Here, Y= variables used for analysis

a= time (1, 2, 3…….. n) for each period

The status of transport safety in the study area is presented in Figure 1. Sustainable transport should arguably be safe transport. If fewer accidents are registered, it indicates that transport is fulfilling one of its sustainability objectives.



Source: Authors' Own Calculation

Table 2: Depot-wise Number of Accidents and CAGR

Depots	2015	2016	2017	2018	2019	2020	CAGR
Faridabad	13	13	8	6	8	3	-22.842
Ambala	14	16	8	8	5	4	-24.321
Gurugram	15	8	9	7	14	3	-17.232
Chandigarh	5	7	3	1	0	3	-43.309
Rohtak	23	29	14	14	8	3	-33.06
Karnal	9	9	11	17	13	2	-15.71
Hisar	22	34	22	19	24	4	-24.238
Rewari	9	11	12	10	4	5	-16.129
Jind	17	16	6	10	4	6	-22.354
Bhiwani	13	13	15	11	5	2	-30.104
Kaithal	22	15	13	10	10	3	-27.883
Sirsa	11	15	13	12	9	1	-32.201
Sonipat	10	24	17	10	3	1	-40.687
Yamuna Nagar	13	6	9	6	9	4	-13.516
Delhi	13	10	10	8	6	0	-16.218
Fatehabad	12	10	9	13	9	2	-22.469
Kurukshetra	12	19	13	2	4	7	-23.205
Jhajjar	7	2	16	9	7	4	1.10563
Panipat	8	12	13	9	8	1	-28.988
Narnaul	5	6	14	16	6	2	-11.934
Charkhi Dadri	0	0	4	1	1	1	-34.025
Palwal	5	4	2	5	4	1	-18.433
Nuh	8	10	6	2	4	1	-33.435

Source: Haryana Statistical Abstract and Authors' Calculation

Table 2 and Figure 1 represent the CAGR of bus accidents from 2015 -2020. It shows the negative growth rate of accidents in all depots except the Jhajjar depot. The Sonipat depot (-40.68) of

Haryana roadways has the highest negative growth rate. The negative accident rate is a good sign for the state transport sector. During the study period, it was also found that the public transport in Haryana is safe. There is only one depot, Jhajjar, which displays positive accident growth. Except for Jhajjar, all other depots show a negative growth rate of accidents. With the help of the above safety indicators, it can be inferred that the Haryana roadways performed well because the accident rates declined over the period.

Conclusion

This study analysed the efficiency and safety of public transport in Haryana to encourage sustainable transport. After working on these two indicators, this study concludes that public transportation in Haryana has a good efficiency score and found a negative growth rate of accidents over time. The efficiency scores of DMUs indicated that only Sirsa and Chandigarh have one efficiency score among all the units. The units of Sirsa and Chandigarh can perhaps be used as a 'proven set'— as a benchmark for the inefficient units. The average OTE score of all selected units is 0.89. This score indicates that these DMUs have 89 percent worked efficiently in 2015-16 to 2020-21. The efficiency score is based on output-oriented, which means that inputs will be constant for attaining total efficiency. There is an 11 per cent scope for reduction in their output. The negative growth rate of accidents witnessed that the public transport of Haryana is working well in terms of safety indicators.

Based on sustainability dimensions (efficiency and safety), the study recommends promoting public transport in Haryana. The results of this study indicate that public transport should be encouraged to reduce the congestion on roads and pathways towards sustainability. To enhance productivity, it is necessary to put new buses on the road and recruit further staff. The infrastructure also performs a critical role in efficiency, like the excellent condition of the road, reducing the number of accidents and time-saving. Moreover, it will enhance the fuel efficiency. All these factors indicate that policy should be worked on specific areas such as the construction of roads, the new job opportunities in the public transport sector and the introduction of new capital and assets in the form of fleet.

The future researcher can take the areas like energy consumption, pollution and hazardous materials involved in public road transport. In addition, the researchers should also examine the financial parameters in terms of revenue and cost-benefit analysis of public state transport undertakings.

References

Abhyankar, N., Gopal, A., Sheppard, C., Park, W. Y., & Phadke, A. (2017). *Techno-Economic Assessment of Deep Electrification of Passenger Vehicles in India*. https://vehicle-grid.lbl.gov/sites/default/files/lbnl-1007121_report_1.pdf.

Agarwal, S. (2016). Evaluation of Efficiency and Effectiveness of Public Transport Sector of India Using DEA Approach. In A. Emrouznejad, R. Bankar, H. Ahn, & M. Afsharian (Eds.). *Proceedings of the 13th International Conference on Data Envelopment Analysis*. 73-83. Braunschweig.

Agarwal, S., Yadav, S. P., & Singh, S. P. (2010). DEA based Estimation of the Technical Efficiency of State Transport Undertakings in India. *OPSEARCH*, 47(3), 216–230. https://doi.org/10.1007/s12597-011-0035-4.

Aneja, R., & Sehrawat, N. (2022). Depot-Wise Efficiency of Haryana Roadways: A Data Envelopment Analysis. *Arthaniti: Journal of Economic Theory and Practice*, 21(1), 117–126. https://doi.org/10.1177/0976747920954973.

Aven, T. (2020). Climate Change Risk–What is it and How Should it be Expressed? *Journal of Risk Research*, 23(11), 1387–1404. https://doi.org/10.1080/13669877.2019.1687578.

Banker, R. D. (1984). Estimating Most Productive Scale Size Using Data Envelopment Analysis. *European Journal of Operational Research*, 17(1), 35–44.

https://doi.org/10.1016/0377-2217(84)90006-7.

Bansal, P., & DesJardine, M. (2014). Business Sustainability: It is About Time. *Strategic Organization*, 12(1). 70-78. https://doi.org/10.1177/1476127013520265.

Buddenhagen, I. W. (1999). The Sustainability of Rice Farming. D. J. Greenland, *The Quarterly Review of Biology*, 74(2). 244-245. https://doi.org/10.1086/393131

Byrne, J. P., Fiess, N., & MacDonald, R. (2011). The Global Dimension to Fiscal Sustainability. *Journal of Macroeconomics*, 33(2). 137-150. https://doi.org/10.1016/j.jmacro.2011.01.002.

Chakrabartty, A., & Gupta, S. (2015). Technical Efficiency of Urban Public Transport Undertakings in India: A Study with Special Reference to CSTC. *Arthshastra: Indian Journal of Economics & Research*, 4(3). 20. https://doi.org/10.17010/aijer/2015/v4i3/71377.

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the Efficiency of Decision-Making Units. *European Journal of Operational Research*, 2(6). 429-444. https://doi.org/10.1016/0377-2217(78)90138-8.

Choudhuri, S. (2019). Research on Sustainable Development in India. *International Journal of Recent Technology and Engineering*, 8(2, Special issue 3), 1210–1215. https://doi.org/10.35940/ijrte.B1226.0782S319.

Greenland, D. J. (1998). The Sustainability of Rice Farming. *Choice Reviews Online*, 35 (7). 265. https://doi.org/10.5860/choice.35-3847.

Dyllick, T., & Rost, Z. (2017). Towards True Product Sustainability. *Journal of Cleaner Production*, 162. https://doi.org/10.1016/j.jclepro.2017.05.189.

Grant, L. K. (2010). Sustainability: From Excess to Aesthetics. *Behavior and Social Issues*, 19(1).7-47. https://doi.org/10.5210/bsi.v19i0.2789.

Hooda, D. & Sehrawat, N. (2021). Performance Analysis of State Transport Undertaking: A Study of Haryana. *International Journal of Research in Social Sciences*, 11(03), 135–142.

James, P., Magee, L., Scerri, A., & Steger, M. (2014). Urban Sustainability in Theory and Practice: Circles of Sustainability. *Urban Sustainability in Theory and Practice: Circles of Sustainability*. 260. https://doi.org/10.4324/9781315765747.

Jothilakshmy, N., & Marudachalam, V M. (2007). Sustainable Transport System. *International Journal on Design and Manufacturing Technologies*, 1(1), 79–84. https://doi.org/10.18000/ijodam.70016

Mensah, J. (2019). Sustainable Development: Meaning, History, Principles, Pillars, and Implications for Human Action: Literature Review. *Cogent Social Sciences*, 5(1). 1-22. https://doi.org/10.1080/23311886.2019.1653531.

Mohapatra, S., Mohanachandran, D., Dwivedi, G., Kesharvani, S., Harish, V. S. K. V., Verma, S., & Verma, P. (2023). A Comprehensive Study on the Sustainable Transportation System in India and Lessons to Be Learned from Other Developing Nations. *Energies*, 16(4), 1–21. https://doi.org/10.3390/en16041986.

Ozili, P. K. (2022). Sustainability and Sustainable Development Research Around the World. *Managing Global Transitions*, 20(3), 259–293. https://doi.org/10.26493/1854-6935.20.259-293.

Orsot-Dessi, P., Ashta, A. & Mor, S. (2023) The Determinants of the Intention to use autonomous vehicles. *African Journal of Science, Technology, Innovation and Development.* DOI:10.1080/20421338.2023.2174754

Ramanathan, R., & Parikh, J. K. (1999). Transport Sector in India: An Analysis in the Context of Sustainable Development. *Transport Policy*, 6(1). 35-45. https://doi.org/10.1016/S0967-070X(98)00030-4.

Singh, S. K. (2017). State Transport Undertakings in India: Status and Issues. *International Journal of Applied Business and*

Economic Research, 15, 279–297. https://www.researchgate.net/publication/322244188.

Szymańska, A. (2021). Article Reducing Socioeconomic Inequalities in the European Union in the Context of the 2030 Agenda for Sustainable Development. *Sustainability,* 13(13). 28. https://doi.org/10.3390/su13137409.

Tiwari, G., & Kharola, P. S. (2008). Urban Public Transport Systems: Are the Taxation Policies Congenial for Their Survival and Growth? *Economic and Political Weekly*. 43 (41), 41-47.

Tordera, N., Peiró, J. M., Ayala, Y., Villajos, E., & Truxillo, D. (2020). The Lagged Influence of Organizations' Human Resources Practices on Employees' Career Sustainability: The Moderating Role of Age. *Journal of Vocational Behavior*, 120. https://doi.org/10.1016/j.jvb.2020.103444

Watz, M., & Hallstedt, S. I. (2022). Towards Sustainable Product Development – Insights from Testing and Evaluating a Profile Model for Management of Sustainability Integration into Design Requirements. *Journal of Cleaner Production*, 346. https://doi.org/10.1016/j.jclepro.2022.131000

Zhao, X., Ke, Y., Zuo, J., Xiong, W., & Wu, P. (2020). Evaluation of sustainable transport research in 2000–2019. *Journal of Cleaner Production*, 256. https://doi.org/10.1016/j.jclepro.2020.120404

Ethical Approval and Conflict of Interest

The authors declare that the study was conducted following the protocols of the Helsinki Declaration and that there is no conflict of interest in relation to the research paper, authorship, and publication of this article.

Author Contribution Statement

Devinder Singh Hooda: Conceptualisation, methodology, cross-checking and amending the references, final appraising, editing, and rewriting the final draft of the paper.

Nitisha Sehrawat: writing and developing the first draft, conceptualisation, methodology, collecting and analysing the data, preliminary reviewing and rewriting the final draft.

Informed Consent

We hereby confirm that while conducting this study, all the required consent were taken.

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