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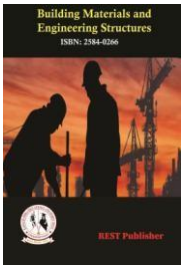

Evaluating Project Alternatives for Transportation System Sustainability: Through the WSM Methodology

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Abstract: *Today, human activities are guided by the notion of sustainable development. Future growth will mostly be influenced by sustainable transportation. Today, this is not the case, and road transportation, in particular, plays a role in this. A paradigm change for the development of sustainable transportation Inland Rivers will inevitably carry more traffic than other alternative routes as a whole. The rationale for enhancing the sustainability of inland canal navigation is discussed in this lecture. Investigating university attendance among Norwegian university students during the winter months for venturing out and using public transportation (PT) was the aim of this study. Investigating traffic attitudes and environmental elements as potential indicators of travel preferences with 441 college students at Norway's Dragvoll and Glshaugen campuses of two universities. 206 men and 229 women participated in this cross-sectional self-report survey. Beyond the aforementioned contextual elements and transportation strategies. The explained variance is increased by the traffic priorities. Exercise transportation priority with increased utilization of active transportation. Flexibility is valued more when it comes to active transit use. Previous studies have shown that a more favorable environment The utilization of active transportation is correlated with attitudes. Comfortable transport attitude is one of the psychological variables in PT. Use is linked to a reduced degree of PT, maybe while employing this modality. conveys discontent. In general, psychological factors (transport priorities, transport attitudes) explained less of the variation in fixed transit use than situational ones (such as campus location, journey distance). Benefits of active transportation in terms of health and the environment Reminding children could be an effective strategy for enhancing this form of transportation. Later in life, increased PT comfort might stimulate sustained use of this treatment method. However, wintertime saw more static traffic. The ability to employ a mode depends on removing situational restrictions, utilization of transportation. Comfortable transport attitude is one of the psychological variables in PT.*

Keywords: *WSM method*

1. INTRODUCTION

Sustainable development strikes a balance between social, economic, and environmental goals. Planning techniques that support sustainable development are referred to as sustainable transport planning, which is the examination of transport policy. This is significant because decisions on transportation planning and policy may have numerous, long-term effects. Systems of sustainable transportation are crucial to the growth of a nation's economy and urban areas. Technologies and other activities that increase system efficiency while reducing adverse effects on the city's environment and social life. For those who make decisions about modern transportation, sustainability is a crucial topic. How is sustainability defined and quantified with accuracy? It has been the subject of numerous discussions. Brundtland Commission (World Commission on Environment and Development of the United Nations, 1987) Future generations will provide for themselves meets modern requirements without sacrificing economy growth is a definition of sustainability. The "triple bottom line" of social equality is used by the World Bank (1996), Lu (2002), and Shipper (2003) in their definitions of sustainability. Interest in these subjects is sparked by several factors. Economic, social, and environmental activities are all part of human life. a setting with significant expenses Concern for sustainability stems from an increasing understanding of our effects. The enduring impacts of produced chemicals, global air pollution. The necessity to view human impacts from a wider perspective is highlighted by the degradation of natural resources like fresh water and fisheries as well as the transboundary nature of many environmental challenges.he World Business Council for Sustainable Development defined sustainable mobility as "the ability to meet the needs of society, free movement, access, today or in the future without sacrificing communication, trade, and other essential human or environmental values"

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(2001). The topic of sustainable mobility has recently come to the forefront across all industries. The causes of numerous issues in contemporary life include air pollution, noise, traffic congestion, safety, security, growing costs, travel delays, and so forth. Transport specialists have developed a number of solutions in one or more of the following strategies to stop these expanding difficulties. For the advancement of commerce and human life, transportation systems are crucial. They also have numerous detrimental effects on human life, including their environment. In order to fulfill the socioeconomic environmental goals of sustainability, they must be efficiently controlled. Principles are crucial in this regard. A policy may increase or decrease the extent of effects on the transportation system. Indicators, which measure how a system or process responds to objectives under certain conditions, are required to evaluate the effectiveness of policies. What actions are necessary to fulfill the city's sustainability goals? Indicators are crucial in helping decision- and policy-makers determine that transportation is a significant industry in any nation energy used in transportation. Manage both the bad and beneficial effects of air pollution to attain sustainability because it is a source of economic and social development. It takes a lot of work to maintain balance. On this premise, to be able to meet the needs of both present and future human generations in terms of economic and social growth, since sustainable transport generally poses no damage to public health or the environment.

2. SUSTAINABLE TRANSPORT

Sustainable transportation is defined as having minimal or no emissions, energy efficiency, accessible modes of transportation, including electric and using domestic and alternative fuels. Driving less while using sustainable transportation decreases all of them. Low and zero emissions equate to sustainable transportation. Energy effectiveness, cost-effective transportation options, including electric, alternative fuel cars, and domestic fuels. Driving less while using sustainable transportation decreases all of them. Sustainable development or sustainable transportation are examples of sustainability Sustainable development does not have a widely agreed-upon concept (Beatley, 1995). Transportation that is sustainable, both now and in the future. It is widely acknowledged that striking the correct balance between the environment and society has both indicators and positive economic effects (e.g., OECD, 1996; Ruckelhaus, 1989; Litman, 2003; WCED, 1987). There is no guarantee of any environmental, social, or economic qualities, and it is unclear what should be balanced. perpetual traffic Despite numerous attempts to develop indicators (see below), appropriate environmental, social, and economic characteristics There isn't currently a consensus on a fundamental set of reflecting indicators. It is ideal to first define sustainable transport before developing theory-based concepts for indicators and perationalization then by acquiring important performance indicators that aid in quantifying sustained traffic. Many performance indicators are developed from stakeholders' opinions of sustainable transportation and are based on current practices (such as in transportation plans and laws). The development of indicators is frequently static or implicit. not based on a transportation-related approach (Gilbert and Tanguay, 2000). By investigating the viability of the transportation system and taking into account positive and negative values, transit, and transportation Extemalities are blatantly apparent now or in the future. Governments employ these metrics (e.g., V&W, 1991; also Gilbert and Tanguay, 2000; Gudmundsson, 2001). Set recurring traffic objectives Check to see if the transportation system is heading in the right direction for sustainability.The development of indicators is frequently static or implicit. not based on a transportation-related approach (Gilbert and Tanguay, 2000).

This article categorizes the importance of some of these sustainable modes of transportation in light of their shared context.

a. Walking. The first, and the most obvious, is that we humans can move about autonomously....
b. Bicycles & Scooters
c. Public Transport
d. Carsharing and Carpooling.

Indicators of sustainability are required to examine the circumstances and potential for sustainable transportation. the financial. systematically analyzing the effects on society and the environment By a number of crucial sustainable concepts It is important to determine how much traffic will influence the indications. Economic indicators, such as macroeconomic changes, GDP, economic performance, income distribution, and unemployment rate, should quantify possible consequences on economic welfare. Social indicators, such as safety and health, are social in nature and indicate changes in a person's quality of life (e.g., OECD, 1976, 1982). Environmental indicators should track the effects of environmental factors that may have an impact on both human and non-human life, such as resource consumption, emissions, waste, soil, water, and air quality (ECD 2002; Steg et al., 2003). Using a back casting approach would meet these requirements. A high-tech situation (technological improvements only), a movement-change scenario (just behavioral changes aimed at reducing car dependence), and a combined scenario (technological and behavioral changes) were the three scenarios they proposed for ecologically sustainable transportation. Next, implement these eco-friendly transportation systems. They conducted an analysis of the required policy actions. Additionally, they contrast the effects of a business as usual scenario on the economy and society. They looked into the potential social and economic effects of the overall circumstance. Experts evaluated social repercussions qualitatively. Environmental indicators should track the effects of environmental factors that may have an impact on both human and non-human life, such as resource consumption,

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emissions, waste, soil, water, and air quality (ECD 2002; Steg et al., 2003). Only if changes in economic structures are taken into account, together with the assumption of a significant increase in technology progress, more radical behavioral modifications, and environmentally sustainable transportation. Their analysis showed that the objectives could be met. Additionally, existing guidelines for the timely use of measuring devices The life cycle must undergo a significant alteration, they determined. The negative effects of environmentally friendly transportation options on the economy and society are frequently severe. It didn't appear as bad as everyone thought. However, environmental perceptions of safety, health, and social They paid attention to the social indices threatened by motorized transportation, such as relationships. Equity, liberty, convenience, and additional crucial social factors including comfort and environmentally friendly transportation if so, it might be especially dangerous for those who have to limit their use of cars.

3. SUSTAINABLE DEVELOPMENT AND TRANSPORTATION

The Sustainable transportation may increase accessibility and encourage economic growth. Better economic integration is achieved through sustainable transportation while maintaining environmental sensitivity. enhancing social justice, health, urban resilience, links between the urban and rural areas, and rural productivity. early in the 1970s. Numerous pieces from "A Map for Survival" (quoted in Hough, 1997) have been released. A sustainable society is necessary, as has already been stated by Numerous studies have covered sustainable development since the 1970s (Newman and Kenworthy 1999; Nijkamp et al. 1998; Cervero 1998; Haq 1997). And it has served as the main issue for a number of national and international conferences. The UN set up the Intergovernmental Panel on Climate Change in 1988. Rio de Janeiro's Earth Summit in 1992, the European Conference of Transport Ministers in 1995, and the Kyoto Conference on Climate Change in 1997). One of the definitions of sustainable development that is most frequently used is The Bruntland Report is also known as the definition presented in the World Commission on Environment and Development's report. According to the paper, sustainable development is necessary to help future generations fulfill their own needs and aspirations. Development is described as "meeting current needs without compromising ability to achieve" in the definition. This term speaks of current, future, and natural resources as well as the welfare of human civilization. It requires acknowledging the ambiguities surrounding both technology and human values. The need for sustainable development: Numerous pieces from "A Map for Survival" (quoted in Hough, 1997) have been released. Since the 1970s, various papers have discussed the necessity for a sustainable civilization (Newman and Kenworthy 1999; Nijkamp et al. 1998; Cervero 1998; Hooke 1997). The establishment of the Intergovernmental Panel on Climate Change in 1988, the UN Rio Earth Summit in 1992, the 1995 European Conference of Transport Ministers, etc., and the Kyoto Convention on Climate Change in 1997 are just a few examples of conferences where sustainable development has been discussed and has been a major theme. One of the definitions of sustainable development that is most frequently used is The World Commission on Environment and Development published a report The Brunt land Report, after its author, is another name for the aforementioned definition. According to the paper, sustainable development is defined as "development that meets current needs without compromising the ability to achieve aspirations" and is necessary for "future generations to meet their own needs." This term speaks of current, future, and natural resources as well as the welfare of human civilization. It requires acknowledging the ambiguities surrounding both technology and human values

4. KEY FACTORS IN TRANSPORTATION

The research (Nijkamp et al., 1998; Masser et al., 1992, 1993; Nijkamp, 1999) supports this. There are five key elements driving traffic growth: government policy, economic pressures, spatial and land use planning. Trends in technology, society, and behavior. Each of these variables changes over time, having an impact on both other variables and the transportation system. Mobile technology, infrastructure design, travel patterns, and motor stage- 324 Y. Shipton et al. / Transportation Research Part D 8 (2003) 323- are some of these aspects and political initiatives. As a result, these elements will determine whether transportation progress is sustainable. Below is a list of the five distinct factors that were discussed in the current study.

- Land use patterns and spatial patterns travel demand, and consequently transport method the size of the urban area, the density of buildings, influenced by the specialization and proliferation of activities in metropolitan areas. because infrastructure and structures have long life spans. There has long been a connection between spatial patterns and transportation.
- Economic factors: Due to the significant financial investment required, large-scale transportation projects are particularly susceptible to economic shifts. The project will last longer and have a lower rate of return the more initial capital is needed.
- By enhancing waste management, lowering pollution, and offering a substitute for physical travel through communication, technology can support environmentally friendly transportation. However, because to factors including the magnitude and expense of projects, long-term research, infrastructure construction, and the extended lifespan of mobile devices, technological advancement in transportation has been rather gradual.
- Government Policy: The growth of transportation is actively supported by the authorities. Allocating rights for future development requires long-term planning for a number of reasons, including the significant financial outlay and taking adverse externalities into account. Consequently, political priorities have an impact on how

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transportation develops. 5. Social and behavioral tendencies: Habits are the basis of personal behavior. a blend of rational and sentimental factors. Therefore, societal conventions and beliefs can have a big impact on how people choose to travel.

5. SUSTAINABLE TRANSPORT AND QUALITY OF LIFE

Whether the economic, social, and environmental systems that comprise the community are providing a healthy, fulfilling existence for all community people, present and future is a key indicator of sustainability. Although not all people and cultures regard quality of life in the same way, some fundamental factors to take into account when assessing quality of life include the existence of environmental pollution, the availability of work, the rates of homelessness and crime, and other similar factors. Whether the economic, social, and environmental systems that comprise the community are providing a healthy, fulfilling existence for all community people, present and future, is a key component of sustainability. Although not all people and cultures regard quality of life in the same way, some fundamental factors to take into account when assessing quality of life include the existence of environmental pollution, the availability of work, the rates of homelessness and crime, and other similar factors. The majority of Level of Service (LoS) measurements are utilized for modes (and increasingly for space-based operations), with transport performance indicators being particularly helpful. LoS metrics support: Minimum service standards and/or for each method (and place) Set desired operational parameters. Markers of social, environmental, and economic progress from the OECD's sustainable transport program According to Joumard and Gudmundsson (2010), sustainability can be defined as statistical measurements. Few attempts have been made to define indicators that would quantify urban sustainable transportation. The second and third techniques are mostly discussed in this paper. This does not imply that the countless contributions made in the field of policy are unimportant. Instead, this chapter's focus is only on the more significant conceptual contributions. This is how traffic sustainability is measured and tracked using various performance measures; it also discusses some of the experiences and implications of utilizing indicators to support or evaluate policymaking.

6. SUSTAINABLE DEVELOPMENT PERSPECTIVE

We Perspective on sustainability: Sustainability Environment, balancing social and economic issues. and places an emphasis on the future to protect the welfare of future generations. The term "sustainability" or "sustainable development" refers to a multifaceted idea that includes economic, social, environmental, and corporate governance considerations. Theoretically, this essay on sustainable poultry production is based on based on a multifaceted comprehension of the idea. It admits that it is complicated and cutthroat. It might be difficult to evaluate or talk about an agricultural sector's sustainability. A systems approach is necessary for the sector because it is a part of the global food system. Incorporating one or more of the four elements into this article gives illustrations of the components. Examples include the usage of antibiotics and pollution, biodiversity and farm workers' well-being, institutional food chain management, and the affordability of poultry produced from high-quality ingredients in many parts of the world (economic issues). To develop chicken production in a sustainable manner, there are various viable routes. Chickens are intelligent, living creatures. Numerous urban and rural farming systems can successfully mix them. The livelihoods of families all around the world profit from and contribute to such institutions, where they place specific emphasis on women. Local production also necessitates little to no transportation. It provides the opportunity for production with little reliance on fossil fuels. Chicken meat or eggs are generated by land animals. Feed to food conversion in terms of energy and water utilization per kg It has the best ratio and the least impact on the environment.

7. WSM Method

WSM is one of the most well-known MCDM methods in decision theory, and it is one of the easiest ways to evaluate options based on specific criteria. Each piece of information is one dimensional. Or WSM is only effective when in a unit. WSM is not a standalone MCDM method that can be applied to multidimensional issues. It is a time-tested technology for designing reinforced concrete as well as structural steel and wood. This approach uses structural material that operates elastically in a straight line. Expected "workloads" in the structure Controlling generated material stresses appropriately Additionally, it takes into account the fact that since the defined allowed stresses are kept below the material strength, acceptable security may be guaranteed. It is seen reasonable to assume that behavior will be linearly elastic. The term "factor of safety" is frequently used to describe the relationship between a material's strength and its permissible stress. However, the primary premise is that behavior and workloads are linearly elastic. Stresses lower than permitted stresses it is thought that the implicit presumption of being able to hold is unrealistic. A number of factors are responsible for this, such as the long-term effort of creep and compression, the effects of stress concentrations and other secondary effects. All such effects result from significant local increases in the redistribution of calculated stresses. The design usually results in relatively large sections of structural members. The result is excellent service ability performance under typical workloads.

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8. RESULT AND DISCUSSION

TABLE 1. Alternative factors

A1	Bus transport
A2	Truck transport
A3	Two wheeler transport
A4	Car transport
A5	Auto transport

Table 1 gives alternatives A1 is Bus transport, A2 is Truck transport, A3 is two-wheeler transport, A4 is Car transport and A5 is Auto transport

TABLE 2. Parameter factors

C1	Accessibility
C2	Safety
C3	Reliability
C4	Quality of service
C5	Benefits to economy
C6	Usage of fossil fuels
C7	Air pollutants
C8	Operating costs
C9	Noise
C10	Waste from road transport

Table 2 gives parameter factors C1 is Accessibility, C2 is Safety, C3 is Reliability, C4 is Quality of service, C5 is Benefits to economy, C6 is Usage of fossil fuels, C7 is Air pollutants, C8 is Operating costs, C9 is Noise and C10 is Waste from road transport.

TABLE 3. given a data set

Alternatives	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
A1	45.12	58.23	65.24	64.12	70.45	25.43	36.12	32.15	18.43	36.12
A2	64.13	42.13	57.12	54.23	65.32	35.42	12.00	24.13	26.43	42.13
A3	54.00	65.25	86.12	69.86	63.14	34.12	42.15	36.24	27.13	35.12
A4	56.32	52.43	45.36	54.76	53.42	36.43	42.15	27.68	31.42	29.54
A5	65.00	69.23	36.96	55.43	42.13	21.00	32.14	19.25	31.21	20.14

Table 1 indicates the information set for the A1, A2,A3,A4 and A5 of the C1,C2,C3,C4,C5,C6,C7,C8,C9 and C10. Segment factors values is high values for the data set. Financial and economic factors are low values for the data set.

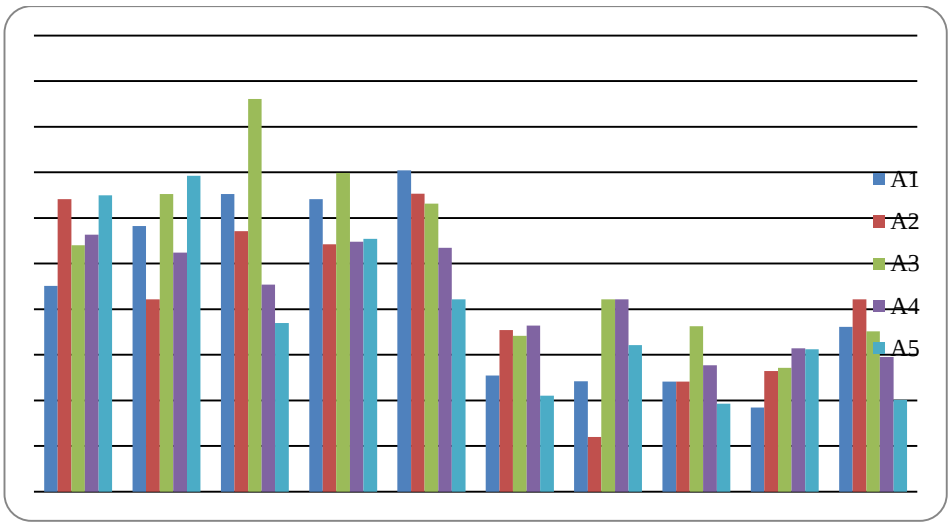

FIGURE 1. Give a data set graph

Figure 1 shows the information set for the A1,A2,A3,A4 and A5 of the C1,C2,C3,C4,C5,C6,C7,C8,C9 and C10. Segment factors values is high values for the data set. Financial and economic factors are low values for the data set.

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TABLE 4. Normalized

A1	0.6942	0.8411	0.7575	0.7575	1.0000	0.6981	0.8569	0.8871	0.5866	0.8573
A2	0.9866	0.6086	0.6633	0.6633	0.9272	0.9723	0.2847	0.6658	0.8412	1.0000
A3	0.8308	0.9425	1.0000	1.0000	0.8962	0.9366	1.0000	1.0000	0.8635	0.8336
A4	0.8665	0.7573	0.5267	0.5267	0.7583	1.0000	1.0000	0.7638	1.0000	0.7012
A5	1.0000	1.0000	0.4292	0.4292	0.5980	0.5764	0.7625	0.5312	0.9933	0.4780

Table 3 gives the normalized data of the data set. Given this data is easily calculated.

TABLE 5. gives weight matrix

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
A1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
A2	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
A3	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
A4	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
A5	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25

Table 5 gives weight matrix all values is taken for same values.

TABLE 6. Weighted normalized decision matrix

A1	0.1735	0.2103	0.1894	0.1894	0.2500	0.1745	0.2142	0.2218	0.1466	0.2143
A2	0.2467	0.1521	0.1658	0.1658	0.2318	0.2431	0.0712	0.1665	0.2103	0.2500
A3	0.2077	0.2356	0.2500	0.2500	0.2241	0.2341	0.2500	0.2500	0.2159	0.2084
A4	0.2166	0.1893	0.1317	0.1317	0.1896	0.2500	0.2500	0.1909	0.2500	0.1753
A5	0.2500	0.2500	0.1073	0.1073	0.1495	0.1441	0.1906	0.1328	0.2483	0.1195

Table 6 gives the weighted normalized decision matrix of the weight. Given this data is easily calculated.

TABLE 7. Preference Score

Bus transport	1.9841
Truck transport	1.9032
Two wheeler transport	2.3258
Car transport	1.9751
Auto transport	1.6995

Table 7 gives Preference Score Bus transport values is 1.9841, Truck transport values is 1.9032, Two-wheeler transport values is 2.3258, Car transport values is 1.9751 and Auto transport values is 1.6995.

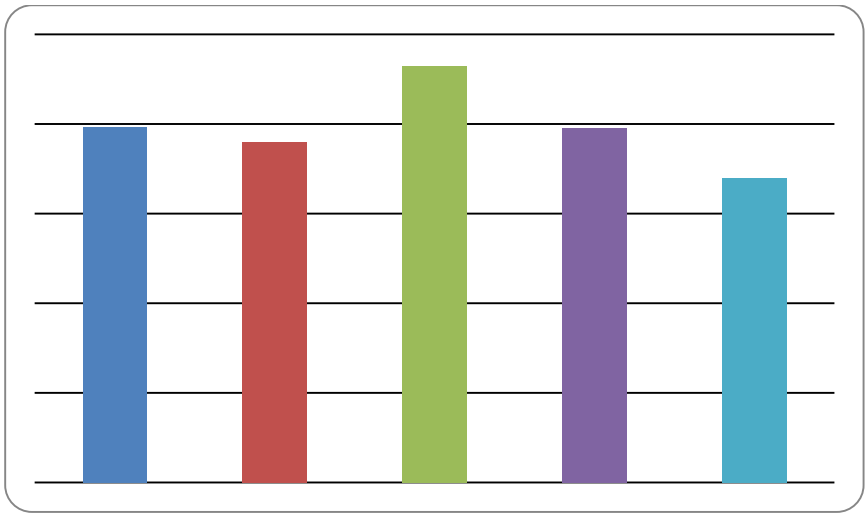

FIGURE 2. Preference Score

Figure 2 shows Preference Score Bus transport values is 1.9841, Truck transport values is 1.9032, two-wheeler transport values is 2.3258, Car transport values is 1.9751 and Auto transport values is 1.6995.

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TABLE 8. Ranking

Bus transport	2
Truck transport	4
Two-wheeler transport	1
Car transport	3
Auto transport	5

Table 8 shows that the Two wheeler transport is in 1st rank, Bus transport is in 2nd rank, Car transport is in third rank, Truck transport is in fourth rank and Auto transport are last rank.

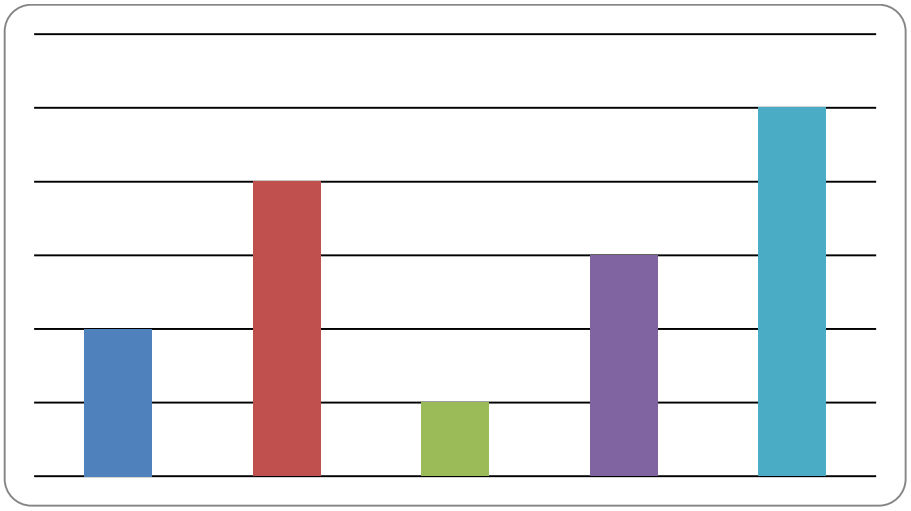

FIGURE3. Ranking

Figure 3 shows that the Two-wheeler transport is in 1st rank, Bus transport is in 2nd rank, Car transport is in third rank, Truck transport is in fourth rank and Auto transport are last rank.

9. CONCLUSION

Previous research on sustainable transportation has only been partially completed or is only focused on the transportation system, which is problematic. Does not employ a mechanism for handling qualitative and confusing information. Increasing need for energy Moreover, due to limited oil stocks the most difficult industry to develop sustainably is transportation. Either approach is reliable. In the context of the energy system, traffic is impassable, and cooperative actions are not possible. Results of research for India demonstrate that operational and transportation systems have both had similar expansion over the years and that they both exhibit contractions. The environment, however, exhibits the opposite pattern. of advancing the economy and transportation It is logical that periods where the environment is negative should be examined. Energy is consumed as a result of higher emissions. Overall, the ecosystem's effectiveness has considerably declined over time. Chosen to safeguard the system the policies have produced fruitful outcomes. Long-term plans must be devised because the environmental mental system's effectiveness is debatable. The study's findings demonstrate that the MCDM technique, when combined with a composite sustainability index, may be used to not only uncover clearly superior options but also take into account trade-offs that various scenarios bring in relation to the priorities given to various sustainability issues. It is discovered that the MCDM Sustainability Index method is especially adaptable in terms of capturing regional goals, which are not static, as a foundation for comparing competing proposals. Although the tool is utilized at the plan level, the same idea can be the basis for creating a tool at the project level that will be used to promote regional sustainability priorities when choosing projects to implement.

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