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Driving Towards Sustainable Transportation Systems: A bottom-up Traffic Modal Choices Analysis Using Responsible Management for Future Development Planning

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ABSTRACT

The transportation sector wields substantial influence on society, encompassing economic, social and environmental dimensions of sustainability. Recognising environmentally conscious actions initiated by individuals, particularly at grassroots levels, fosters the development of a pro-environmental social identity. The article aims to analyse the transportation systems from a bottom-up perspective within a municipality. Consequently, three objectives are proposed for this research paper: investigate citizen behaviour regarding transportation, assess the strengths and weaknesses of communities based on citizen perspectives and generate ideas for improving transit through responsible management principles using a bottom-up approach. It has been determined that private car is the most commonly used mode of transportation. The number of cars is the only variable that influences the choice of transportation. A significant positive relationship has been identified between the number of cars and car travels, while a negative relationship has been observed between the number of cars and travels by transit, pedestrian or bicycle. In addition to this, other significant relationships were determined. Regarding the second objective, the majority of the interviewees perceive that the commune lacks any significant strengths. In terms of enhancement opportunities, respondents express a desire for improvements in pedestrian and cyclist infrastructure, transit facilities and the addition of more lanes and roads.

KEYWORDS

green mobility; traffic; sustainable transportation; sustainable development; responsible management.

1. INTRODUCTION

Human behaviour is the main drawback in tackling environmental decline, and it is fundamental that this issue be tackled in order to fight climate change [1]. Numerous ecological behaviours exhibit a divided tension between hedonic and utilitarian objectives as opposed to normative objectives, necessitating individuals to willingly expend resources or incur costs in order to promote environmental well-being [2]. Significant environmental crises are fundamentally collective in nature, typically arising from communal rather than individual actions, and their cognitive conceptualisation and evaluation are contingent upon collectively embraced interpretations, which may diverge among ideological factions [3]. These evaluations are rooted in a focus on the welfare of collective entities, such as humanity and future generations, as opposed to individual concerns [4].

There is a growing trend of bottom-up initiatives emerging, often initiated by community members themselves, with the aim of promoting environmentally responsible behaviours within their larger collective. Recognising such environmentally friendly initiatives as originating from ordinary group members, i.e. initiated from the grassroots, fosters the development of a pro-environmental social identity, thereby enhancing and motivating corresponding behavioural responses [5].

It is known that the three pillars of sustainability are economic, social and environment. The realm of transportation wields a substantial influence over society, touching upon economic, social and environmental dimensions. To realise sustainability objectives within urban locales, it is imperative to accord priority to transportation. [6]. Traffic congestion generates environmental degradation through the excessive emission of gases into the atmosphere due to high fuel consumption or elevated levels of noise pollution. [7]. Transit represents a smart, effective and environmentally friendly travel modes. It is of paramount importance that such sustainable public transit systems facilitate efficient and cost-effective journeys for society, minimising both travel time and distance [8, 9]. Given the increasing focus on integrating sustainability into the worldwide urbanisation process, there is a need to transition the existing transportation system into a future-proof, sustainable Green Transportation system by deploying advanced technologies and adopting innovative management strategies. [10]. Nevertheless, the pursuit of a sustainable future represents but a fraction of the overall equation in terms of fostering responsible development for the future. In order to achieve genuine responsible management, it is imperative to adhere to the principles of sustainability outlined in the triple bottom line framework. Additionally, it is crucial to consider Responsibility Management, which involves maximising stakeholder value rather than solely focusing on shareholder value, as well as Ethics Management, which aims to attain moral excellence [11].

The urgency and criticality of prioritising sustainability have been widely acknowledged due to the impact of climate change on global regions and the exacerbation of resource scarcity caused by factors such as global population expansion, urbanisation, and economic development [12, 13]. Transportation is a crucial component in the realm of urban sustainability planning and efforts to mitigate greenhouse gas (GHG) emissions. This is because public modes of transportation, as well as walking and cycling, are actively promoted due to their relatively lower generation of negative externalities when compared to private motorised transportation options. [14, 15]. There are global initiatives, such as the 2015 Paris Agreement, in order to enhance the worldwide reaction to the threat of climate change by implementing measures to restrict the increase in global average temperature to below 2°C, with a preference for achieving a limit of 1.5°C above pre-industrial levels [16].

The article aims to analyse the transportation systems from a bottom-up perspective within a municipality. This research identifies respondents preferred ways to travel during the day, and analyse this behaviour based on destination, time slot, transportation type, age and others. The authors analyse the communes' strengths and weaknesses starting from the perception of the inhabitant. Such bottom-up approach is highly valuable, as environmental crises are fundamentally collective in nature. That being said, we propose the following three objectives for this research paper:

1) What is the behaviour of the citizen?
2) What are the commune's strengths and weaknesses based on citizen belief?
3) What ideas result to improve transportation modes through the principles of responsible management?

2. LITERATURE REVIEW

There has been a lack of extensive approaches for evaluating the sustainability of transit and systems. However, new research endeavours have sought to incorporate environmental, social and economic aspects on a broader scale [17, 18]. The absence of a globally acknowledged definition of transportation sustainability has been demonstrated through transport initiative and practice assessments. Consequently, transportation authorities and players are tasked with determining their own perspectives, priorities and areas of emphasis with regards to sustainability [19].

It has been studied that customer loyalty regarding transit is correlated to the degree of satisfaction attributed to these services [20]. The higher the perceived quality of the transit service, the higher loyalty customers have [21]. A study revealed that pedestrians, train commuters and bikers exhibit higher levels of satisfaction compared to drivers, metro riders and bus passengers. It is also that external factors, such as rain, wind and traffic can play a significant role in the satisfaction with travel means [22]. In order to facilitate the

widespread adoption of soft mobility, similar to the successful implementation of road infrastructures for automobiles, it is necessary to incorporate bike and pedestrian paths into programming initiatives while adhering to specified criteria [23]. Similar studies indicate that the ability to predict transit schedule and rely on the journey times was the most significant factor in the willing to use transit, transport quality coming as a close second [24–26]. A study done in Cairo shows that better urban planning and transport system diversity were also found to increase the acceptance of green transportation [27].

According to a recent study conducted by Goldmann and Wessel [28] it was discovered that towns characterised by a greater proportion of young individuals and a well-developed cycling infrastructure exhibit a higher level of resilience in terms of bicycle utilisation. The utilisation of one-way bike sharing schemes exhibits seasonal variations, with a greater prevalence during the summer season compared to the winter season [29].

The primary objective of environmental sustainability in the context of transit services is to mitigate and eliminate adverse impacts. These impacts encompass a range of factors, such as the reduction of greenhouse gas (GHG) emissions, air pollution (specifically nitrogen oxides, particulate matter, sulphur oxides and ozone), noise pollution and trash generation. Furthermore, it is important to address the promotion of renewable resources and the enhancement of material and energy efficiency. Moreover, it is essential to utilise emissions per passenger as a metric, enabling a comprehensive comprehension of emissions in correlation to the number of passengers [30, 31].

The fundamental components of economic sustainability encompass various factors, including the magnitude of transportation, the level of ridership, the costs incurred by service providers, the money generated from fares and the overall financial stability. Additionally, considerations of infrastructure capacity and operating efficiency are crucial in ensuring economic sustainability. The United States Environmental Protection Agency (EPA) utilises average ridership and revenue as key metrics to assess the economic viability of a given entity. The infrastructure and services should possess adequate capacity and be implemented and routed in a cost-effective manner, taking into consideration potential future expansion. [30, 32].

The feature of social sustainability is widely acknowledged as being intricate and demanding to quantify, making its incorporation into transportation planning and policy particularly problematic. The social and economic components sometimes exhibit a degree of intersectionality. Social sustainability encompasses various components and indicators pertaining to factors such as accessibility, safety, health, availability of information, attractiveness, commitment to plans and coordinated management. Consequently, it also encompasses aspects related to governance [3, 33 – 39]. Public transport must provide viable transport services to socially disadvantaged people to allow them to undertake essential social and economic activities [40].

With the emergence of novel transportation technology, an increasing number of individuals who formerly relied on buses as their primary mode of transportation are transitioning to alternative forms of travel. Private autos are considered to be the most appealing transportation modes. In contrast to city buses, private automobiles offer individuals with heightened levels of luxury, privacy and convenience, resulting in a decreased inclination to utilise bus transit [41, 42]. According to other research findings, a range of 17% to 47% of participants indicated a reduction in their utilisation of bus services as a result of the availability of bike sharing programs [43 – 45]. The decline in ridership results in reduced revenue, necessitating the need for more federal, state and municipal funding for transit systems. Consequently, this places a heavier financial burden on the public sector.

3. METHODOLOGY

The article aims to analyse the transportation systems within a municipality. Consequently, a survey in the form of an online questionnaire was administered in the period of 21 May 2022 to 1 August 2022, to ascertain the travel habits of the residents. The quantitative and qualitative assessment of data collected through the engagement of individuals in market research was conducted within the commune of Dumbrăvița, located

in Timis County, Romania. The population of the commune, consisting of a multitude of ethnicities and religious affiliations, is continuously growing, with the active population recorded as 19,339 inhabitants in June 2022. During the period of 2005–2015, the Dumbrăvița commune experienced the highest population growth in the vicinity of the city of Timișoara (by 182%). However, this growth has not translated into efficient development of transportation infrastructure. Regarding population density, in the year 2020, the population density in Dumbrăvița was 815.65 inhabitants per square kilometre.

The questionnaire consists of four parts:

1) Respondent behaviour – This section comprises closed-ended questions with a single response option.
2) Description of the "n" selected trips from the previous question – This section is based on the respondent's behaviour identified in the previous section and requests details about the "n" trips that a respondent makes in a day. It includes closed-ended questions with a single response option or multiple response options.
3) Commune development – This section comprises open-ended questions, allowing respondents to provide their own assessments regarding the dimensions under investigation.
4) Respondent identification – This section consists of closed-ended questions with a single response option.

All the data has been transposed into variables and utilised for statistical analysis: number and type of vehicles owned in the household; frequency of travel by household members in a day; time interval, destination, and origin of each journey; mode of transportation used for each journey; purpose of each journey; opinions and suggestions; strengths and weaknesses of the locality; personal demographic data; total number of individuals in the household and residents in the locality. At the end of the questionnaire administration, the data was analysed using statistical software.

4. RESULTS AND DISCUSSION

A total of 726 valid responses have been registered by our online survey. The first question was regarding the number of trips the respondent has on average in a given day. They could choose between 1 and more than 10 trips per day. The average mobility is calculated to be 3.55 trips/day. Given this response, the questionnaire then guided them to questions regarding each individual trip. Most respondents range between 2 to 4 trips per day, most of them having two trips per day (26.7%) (*Table 1*).

Table 1 – Number of trips per day

Number of trips per day	Frequency	Percent	Cumulative percent
1	64	8.8	8.8
2	194	26.7	35.5
3	139	19.1	54.7
4	147	20.2	74.9
5	78	10.7	85.7
6	58	8	93.7
7	18	2.5	96.1
8	11	1.5	97.7
9	1	0.1	97.8
10	7	1	98.8
More than 10	9	1.2	100
Total	726	100	

Additionally, we wanted to analyse the transportation modes that our respondents own. The options that were presented to them were bicycles, motorcycles/mopeds, scooters/segways and cars. In *Figure 1*, we can see that only 142 respondents do not have a bicycle. Upon calculating the percentage, we would observe that this accounts for approximately 19% of the total. The rest, i.e. 80.4%, own between one to seven bicycles,

while the majority have two bicycles. The distribution of cycling behaviour can provide valuable insights to researchers and policymakers regarding the normal patterns of cycling within a specific group (*Figure 1*).

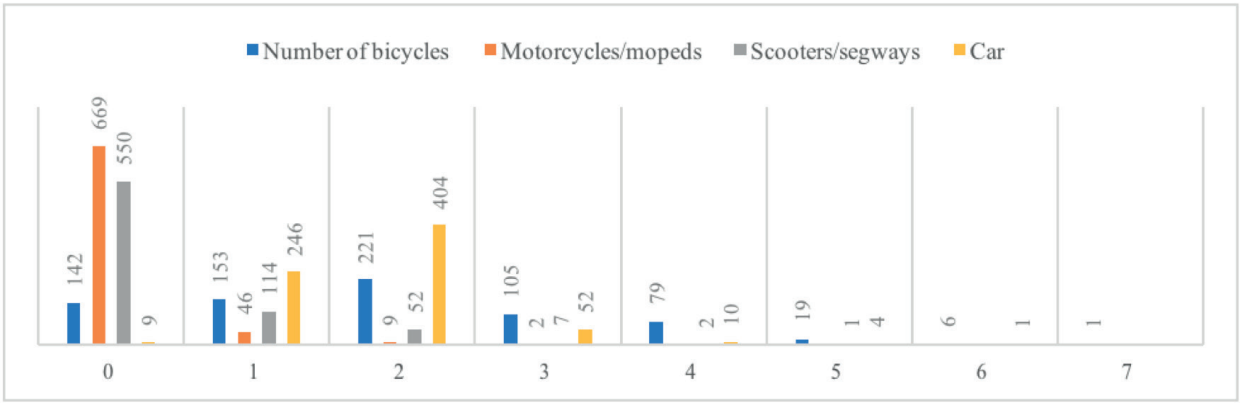

Figure 1 – Transportation modes ownership

Moving on, we wanted to find out the relationship between the transportation modes and a series of other variables. The following calculations are based on the total number of trips. The 726 respondents made a total of 2578 journeys.

First, we aim to analyse the relationship between the mode of transportation and the frequency of trips undertaken. Our findings indicate that the most popular transportation modes are private cars (91%), followed by bicycle, transit and ending with walking. As the number of trips increase, we can see a decrease in pedestrian and transit, and an increase in private cars and bicycles. This may be correlated to the advantages of private cars in terms on comfort or bicycle in terms of speed (*Table 2*).

Table 2 – Trips per day through different modes

Number of trips per day	Pedestrian	Private car	Bicycle	Transit	Sum
1	2	55	4	3	64
2	14	350	13	12	388
3	4	383	19	11	417
4	5	547	27	9	588
5	11	352	20	9	390
6	9	321	13	5	348
7	0	116	11	0	126
8	0	75	9	4	88
9	0	9	0	0	9
10	2	68	1	0	70
11	2	83	3	3	90
Total	48	2356	120	54	2578

Secondly, we wanted to analyse the relationship between trip purpose and transportation modes. This dataset may prove valuable to transportation researchers that are interested in examining travel behaviour and preferences within various trip goals. The most commonly observed trip purposes are “Home–Work” (555 total) and “Home–Recreational/Commercial” (404 total). Common trip purposes include commuting between work and home, as well as traveling between home and educational institutions. Some individuals use a combination of transportation modes for certain trips. For instance, for “Work–Home” trips, there are trips that involve both “Private car” (514 responses) and “Bicycle” (19 responses). The aforementioned data possesses significant value for transportation planners and policymakers as it enables them to gain insights about the demand for various transportation modes, contingent upon the purpose of the trips (*Table 3*).

Table 3 – Trip purpose through transport mode

Purpose of trips	Pedestrian	Private car	Bicycle	Public	Sum
Home –Work	9	514	19	13	555
Work –Home	5	344	16	12	377
Home– Education unit	5	308	14	3	329
Education unit–Home	3	203	9	4	218
Work–Education unit	1	58	2	1	61
Education unit– Work	0	62	4	0	66
Recreational/ Commercial–Home	7	275	18	5	306
Home–Recreational/ Commercial	11	359	26	8	404
Other	8	233	13	9	262
Total	48	2356	120	54	2578

Furthermore, our aim was to identify the relationship between modes of transportation and the highest level of education attained. Private automobile is the prevailing transportation mode across all levels of education, except for vocational school, where fewer journeys were undertaken via private cars. The utilisation of transit is comparatively lower in comparison to private automobiles, although the absolute value grows increasingly prevalent among individuals with greater levels of education. However, if we were to calculate the relative values based on educational attainment, we would find that, proportionally speaking, individuals who have completed vocational school, as well as those with doctorate or post-doctorate degrees, most frequently utilise transit.

It is noteworthy that alternative modes of transportation, as opposed to driving, are utilised by individuals with vocational schools and those with advanced degrees (doctorate, post-doctorate). While we may infer that individuals with vocational training have lower incomes, thus influencing their choice, the rationale for doctorate or post-doctorate holders could be their informed understanding of sustainable implications.

The data has the potential to provide policymakers with valuable insights regarding the necessity of accessible and efficient transportation alternatives, particularly in relation to institutions of higher education. Moreover, this observation may indicate the significance of advocating for sustainable transportation options, such as cycling or public transit, within the vicinity of educational institutions (*Table 4*).

Table 4 – Trip education level through transport mode

Education level	Pedestrian	Private car	Bicycle	Public	Sum
Primary/Secondary school	0	15	0	0	15
Vocational school	6	4	1	1	11
High school	7	162	5	8	182
Post-secondary education	1	16	0	1	18
Short-term higher education (university colleges) in the period 1948–2008	0	84	2	4	89
Bachelor's degree (Bologna system 3–4 years or long-term 4–6 years)	16	1059	55	16	1146
Master's degree	17	923	38	18	995
PhD	1	83	12	5	101
Post doctorate	0	12	8	2	21
Total	48	2356	120	54	2578

Additionally, we wanted to analyse the modes of transportation used during different time slots. During the morning peak hours, which typically span from 06:00 a.m. to 09:00 a.m., private cars are the predominant transportation modes, followed by bicycles and transit. During the evening peak hours, specifically

between 06:00 p.m. and 09:00 p.m., private automobiles regain their prominence as the prevailing form of transportation, whilst pedestrian and bicycle usage experiences a decline in frequency. During the mid-day time slots of 09:00 a.m.–12:00 p.m. and 12:00 p.m.–03:00 p.m., there is a comparatively reduced frequency of trips utilising "Private car" and "Public" transit. This data can be utilised by policymakers and urban planners to evaluate the necessity of enhancing transportation infrastructure during periods of high demand. The data has the potential to influence decision-making processes related to the development of transit schedules and cycling infrastructure (*Table 5*).

Table 5 – Time slot through transport mode

Time slot	Pedestrian	Private car	Bicycle	Public	Sum
06–09	10	682	27	15	733
09–12	5	225	17	8	255
12–15	5	231	10	9	255
15–18	9	551	27	7	595
18–21	15	560	26	7	607
Another range	5	108	13	8	133
Total	48	2356	120	54	2578

Last but not least, we present the data on the transportation choices of individuals for all the trips, categorised according to their respective vocations (*Table 6*). The occupation category that is most frequently observed among respondents is "employee", whereas the prevailing method of transportation utilised by employees is the "private car".

If we were to calculate the relative values based on occupation, we would observe that retirees have the lowest percentage for private car usage. Therefore, we can conclude that retirees are more likely to use alternative modes of transportation such as bicycles or public transit. Moreover, if we were to compare the percentage values of employees or entrepreneurs, we would identify that in the second position for both categories lies the bicycle, with nearly 5% of their respective category (*Table 6*).

Table 6 – Occupation and transport mode

Occupation	Pedestrian	Private car	Bicycle	Public	Sum
School student	0	4	0	0	4
University student	2	42	3	0	46
Employee	32	1727	89	42	1889
Entrepreneur	10	412	20	3	444
Self employed	2	110	5	2	119
Unemployed	1	23	0	1	24
Retired	2	40	4	7	52
Total	48	2356	120	54	2578

To dig deeper under our study, we wanted to see the effect of age, education and number of different transportations modes on the amount of car trips, transit trips, bicycle trips and pedestrian trips. Our findings are as following: When studying Car Trips as the dependent variable, we can see statistically significant positive results for Number of cars, number of persons per trip. Additionally, there has been a significant negative result for number of bicycles. That means that the more bicycles a person has, the less likely they are to have many car trips in a day (*Table 7*).

Table 7 – Linear regression analysis, car trips dependent variable

Model	B	Std. error	Beta	T	Sig.
(Constant)	.745	.032		23.515	.000
No. of bicycles	-.013	.003	-.085	-3.881	.000
No. of motorcycles/ mopeds	-.027	.012	-.044	-2.282	.023
No. of cars	.045	.006	.153	7.758	.000
No. of persons/trip	.062	.004	.272	14.298	.000
Dependent variable: Car trips					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	11.899	8	1.487	32.932	.000b
Residual	116.031	2569	.045		
Total	127.931	2577			
a. Dependent variable: Car Trips					
b. Predictors: (Constant), age, education, no. of bicycles, no. of trips/day, no. of bicycles, no. of motorcycles/mopeds, no. of scooters/segways, no. of cars, no. of persons/trip					

Moving on, we have done the same analysis, but this time the dependent variable is the amount of transit trips. Here, we have two statistically significant results, with a negative relationship. It is observed that there is a negative correlation between the utilisation of transit and both the number of private vehicles owned and the educational attainment of individuals on a particular day. The other tests done yielded no statistically significant findings (*Table 8*).

Table 8 – Linear regression analysis, transit trips dependent variable

Model	B	Std. error	Beta	T	Sig.
(Constant)	.164	.028		5.924	.000
Education	-.009	.003	-.057	-2.881	.004
No. of cars	-.026	.005	-.105	-5.136	.000
Dependent Variable: Transit Trips					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	1.780	8	.223	6.438	.000b
Residual	88.793	2569	.035		
Total	90.573	2577			
a. Dependent Variable: Transit					
b. Predictors: (Constant), age, education, no. of bicycles, no. of trips/day, no. of bicycles, no. of motorcycles/mopeds, no. of scooters/segways, no. of cars, no. of persons/trip					

We followed along with the same type of analysis. As expected, the number of bicycles and motorcycles/ mopeds has a significant positive correlation with the amount of bicycle trips in a day. On the other hand, it is also expected that the same significance should be between the latter and cars, but this time the standardised coefficient shows a negative number. Interesting results are seen in the case of age and education. While the respondent gets older, it tends to have less bicycle trips in a day. This could be attributed to the fact that as we grow, we put greater emphasis on the importance of comfort that our own car brings. It might also correlate to the fact that as we get older, we are more financially stable and can afford individual transportation modes (*Table 9*).

Table 9 – Linear regression analysis, bicycle trips dependent variable

Model	B	Std. error	Beta	T	Sig.
(Constant)	.089	.036		2.471	.014
Age	-.014	.006	-.047	-2.377	.018
Education	.016	.004	.077	3.976	.000
No. of bicycles	.029	.004	.165	7.485	.000
No. of motorcycles/ mopeds	.050	.014	.071	3.668	.000
No. of cars	-.034	.007	-.104	-5.194	.000
No. of persons / trip	-.048	.005	-.184	-9.557	.000
Dependent variable: Bicycle trips	Sum of Squares	df	Mean Square	F	Sig.
Regression	11.257	8	1.407	23.940	.000b
Residual	150.999	2569	.059		
Total	162.256	2577			

a. Dependent variable: Bicycle

b. Predictors: (Constant), age, education, no. of bicycles, no. of trips/day, no. of bicycles, no. of motorcycles/mopeds, no. of scooters/segways, no. of cars, no. persons/trip

The final dependent variable that we wanted to assess was the number of trips done by foot. Here, we see that as people grow older, they prefer to be pedestrians. We also found negative significant correlations between the latter, education and the number of cars owned. The higher the education or number of cars owned by an individual, the less likely they are to become a pedestrian (*Table 10*).

Table 10 – Linear regression analysis, pedestrian trips dependent variable

Model	B	Std. error	Beta	T	Sig.
(Constant)	.138	.025		5.463	.000
Age	.012	.004	.061	3.005	.003
Education	-.014	.003	-.100	-5.087	.000
No. of cars	-.022	.005	-.099	-4.828	.000
No. of persons / trip	-.011	.003	-.062	-3.150	.002
Dependent Variable: Pedestrian Trips					
Model	Sum of squares	df	Mean square	F	Sig.
Regression	1.953	8	244	8.511	.000b
Residual	73.687	2569	.029		
Total	75.640	2577			

a. Dependent variable: Pedestrian

b. Predictors: (Constant), age, education, no. of bicycles, no. of trips/day, no. of bicycles, no. of motorcycles/mopeds, no. of scooters/segways, no. of cars, no. persons/trip

The third part of our questionnaire consists of three different open questions regarding the strengths, weaknesses and potential opportunities for the commune. The analysis of these qualitative results represents a crucial step in developing improvement strategies based on the bottom-up approach. Because the questions were open ended, no result was the same. Thus, we went through every individual response and tried to find the common ground between them, to group them into categories. Therefore, we created eleven different categories, such as transit, safety, bicycle infrastructure, etc. The ones that did not offer an answer or thought that there are no strengths were placed in the "none" category.

Looking at the results, most of the respondents believed that the commune had no strengths. Of course, this result should be taken with a grain of salt, but the general feeling is that there are improvements to be made across all development directions. People also believed that the transit is a strength for the commune, as well as efficient infrastructure and the strategic location of the commune, as seen in (*Figure 2*). Other perceived strengths were the strategic location of the commune (32), efficient infrastructure (27), network of connecting roads (22), side streets (21), safety (15) and so on. Enhancing accessibility may suffice in certain situations, but in other situations when consumers have a stronger emotional connection to their private motor vehicles, it may be necessary to give additional perceived quality characteristics [46].

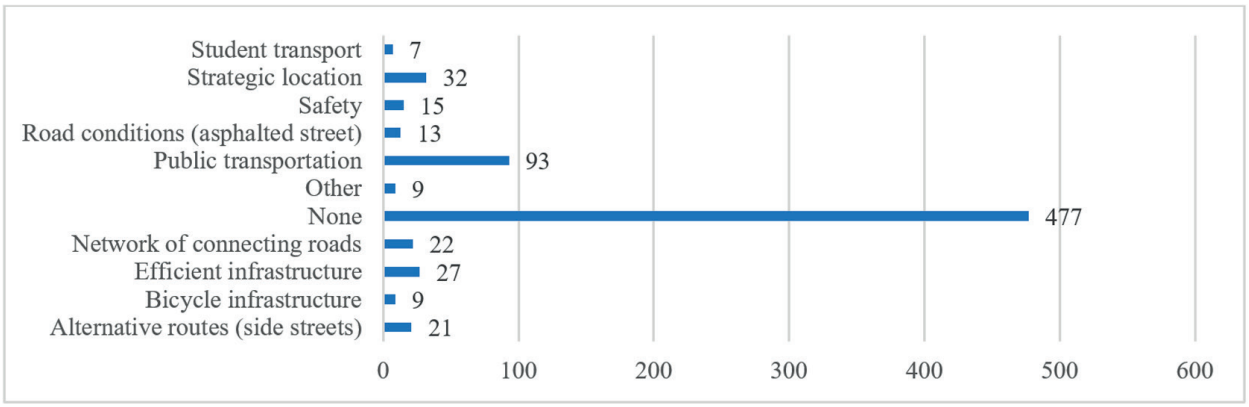

Figure 2 – Bottom-up perceived strengths

The next set of open-ended questions were regarding the perceived weaknesses. We have grouped the results in similar categories, for a better visualisation and understanding of the results. Studying the perceived weaknesses from the bottom-up approach offers highly valuable information for policymakers. Here, we can see that there is a perceived lack of infrastructure for pedestrians and cyclists. The presence of such infrastructure was shown to promote green means of transport adoption [23]. Even though one of the strengths was the presence of transit, we can also find it as a weakness. Overall, poor transit (84), bad infrastructure (52), insufficient roads (46), narrow roads (39), insufficient lanes (28), traffic congestion (38) and so on, were all weaknesses perceived by the inhabitants, as seen in (*Figure 3*). Similar studies indicate that if we seek to improve the quality of transit through a bottom-up approach, the highest degree of perceived quality was associated to transport quality and tractability [24–26]. Other studies about desired qualities found that it is important for the transit system to offer customers convenient departure schedules, brief route durations, cleanliness and minimal stops [47, 48].

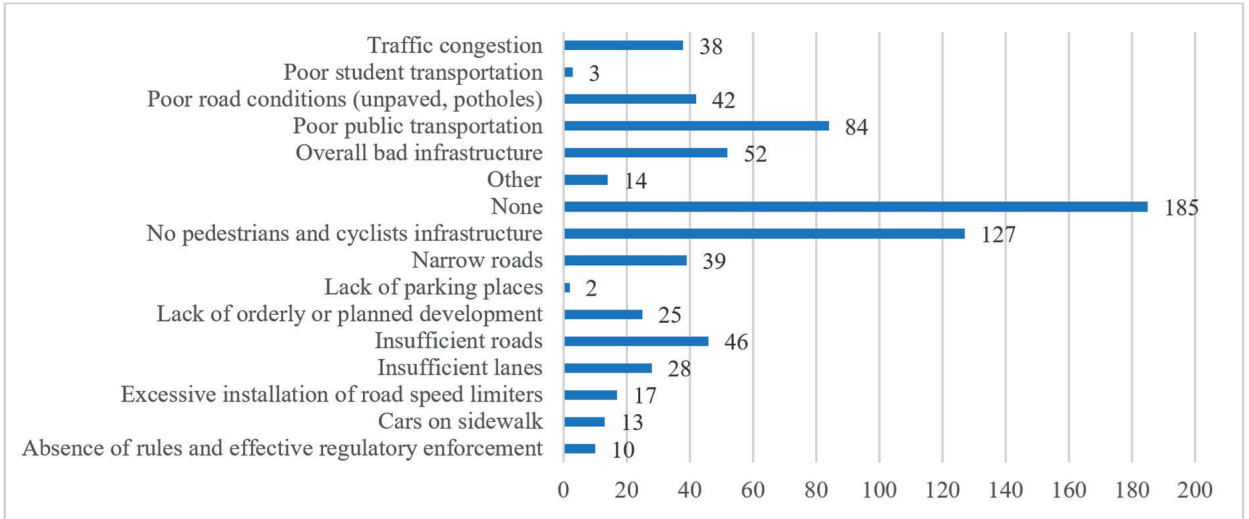

Figure 3 – Bottom-up perceived weaknesses

The next part of our questionnaire was to find out the desires of inhabitants regarding the future development for traffic development. We believe that these results represent the most important part to properly propose strategies from a bottom-up approach. Here, we can see that respondents wish that there were improvements in the pedestrian and cyclist infrastructure, improvement in transit conditions and adding more lanes and roads (*Figure 4*). Numerous demands were from an infrastructure standpoint. A total of 142 respondents showed their desire for the enhancement of sidewalls and bike paths (142), while 96 respondents wished that more lanes would be built. More roads (54), enhancing the quality of roads (34), one-way streets (41) were all seen as opportunities for improvement for the commune. These results fit into the current literature on the given subject. Combining perceived and desired qualities of transit, numerous studies show that it is paramount to have short trip durations, cleanliness and tractability [24–26, 47, 48].

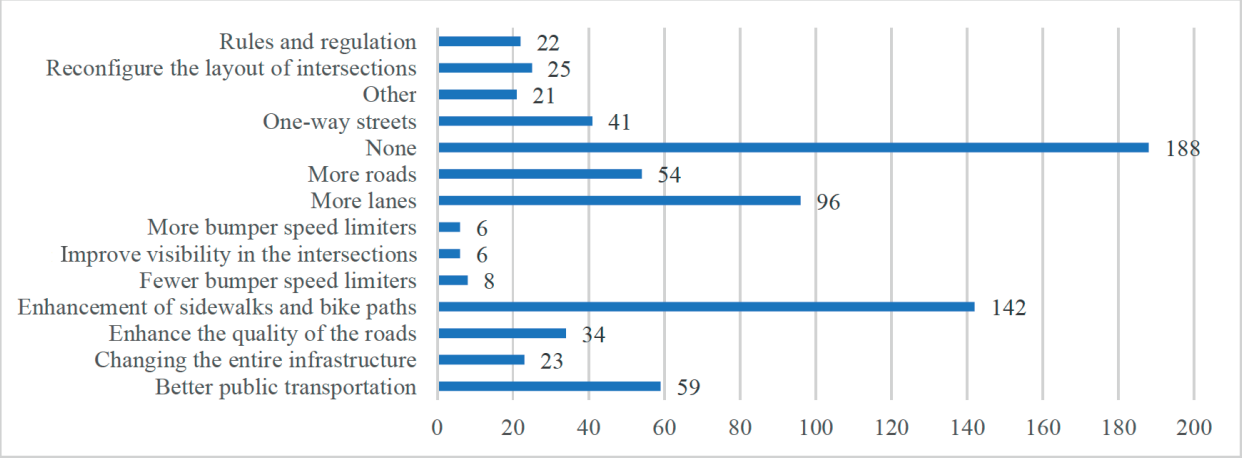

Figure 4 – Commune opportunities

The analysis of the aforementioned data can prove beneficial for urban planners and policymakers. Our bottom-up approach is highly valuable in this research field, as studies show that transit service providers would gain advantages by recognising user-perceived characteristics while addressing quality enhancements [26, 46, 48]. For example, promotion of cycling as a viable mode of transportation can prove beneficial for urban responsible development. The bicycle ownership distribution provides valuable insights for the development of focused activities. In regions characterised by low bicycle ownership rates, endeavours aimed at promoting cycling may prioritise strategies such as enhancing bicycle accessibility or mitigating obstacles to ownership. The observation that an increase in the number of bicycles leads to a decrease in the number of car journeys within a given day is a significant finding. This finding has implications for developing strategies aimed at promoting environmental sustainability within the transportation sector.

The observed negative association between transit usage frequency, education and number of cars owned can be linked to the existing body of literature on customer loyalty in the context of physical therapy. Individuals with a higher level of education tend to place a higher degree of significance on the quality of a certain service. In order to increase the quality perceived and desired by customers, public authorities should focus on cleanliness, tractability and shortening trip duration [24 – 26, 47, 48]. The aforementioned statement can also be used on individuals who possess many automobiles. Individuals place a high value on the comfort provided by their own vehicle. The same negative correlation can be seen in the case of bicycle trips and age. We suspect that the emphasis on comfort is again the reason for this. Also, it seems that education has a positive impact on the amount of bicycle trips in a day. This might be associated to a higher understanding that bicycle transportation modes are a better environmental choice than individual cars.

Citizens are happy that a transit system exists, but they are unsatisfied with the quality thereof. If the perceived quality is low, then the customer loyalty towards it will suffer [20, 21]. Overall bad infrastructure, insufficient roads/lanes are also a common answer, which inherently lead to traffic congestion. Thus, we have proposed the following strategies, based on the in-depth analysis of both the qualitative and quantitative

results of the survey. The strategies are presented through the lens of advantages generated by the responsible management principles. The table should act as a framework for decision makers when they wish to improve advantages for different stakeholders through different advantages based on the RM principles.

Table 11 – Future Development Planning Through Responsible Management

Strategies	Responsible management principles	Public authorities	Citizens	Companies
1. Enhance of sidewalks and bike paths 2. Enhance the quality of the roads 3. Better transit 4. Improve visibility in intersections 5. More bumper speed limiters	Economic	Increased tourism, increased commune attractiveness	Cheaper transportation modes	Fewer cars, faster delivery times, bicycle rental potential
	Social	Safer environment for citizens	Safer environment, reduced social isolation, increased perceived quality	Safer environment for employees
	Environmental	Less congestions, less GHG emissions, less noise pollution		
	Responsibility management	Yes, it is in the interest of all stakeholders		
	Ethics management	Yes, it is ethical		
6. More traffic lanes/roads/one way streets	Economic	Improved urban development	Reduced fuel consumption due to reduced congestion	Supply chain efficiency, reduced transportation costs
	Social	Time saving	Time saving, increased perceived quality	Time saving
	Environmental	Less congestions, less GHG emissions, less noise pollution		
	Responsibility management	Yes, it is in the interest of all stakeholders		
	Ethics management	Yes, it is ethical		
7. Enhance Rules and regulations	Economic	Enhanced tourism, regulation fees	Reduced accidents and healthcare cost, lower insurance premiums	Reduced accidents and healthcare cost, lower insurance premiums
	Social	Safer roads		
	Environmental	Cleaner air quality		
	Responsibility management	Yes, it is in the interest of all stakeholders		
	Ethics management	Yes, it is ethical		

5. CONCLUSION

The article aims to analyse the transportation systems from a bottom-up perspective within a municipality. Consequently, three objectives are proposed for this research paper: investigate citizen behaviour regarding transportation, assess the strengths and weaknesses of communities based on citizen perspectives and generate ideas for improving transit through responsible management principles using a bottom-up approach.

It has been determined that private car is the most commonly used mode of transportation. The number of cars owned is the only variable which influences the choice of transportation (private car, transit, bicycle or pedestrian). A significant positive relationship has been identified between the number of cars owned and

car travels, while a negative relationship has been observed between the number of cars owned and travels by transit, pedestrian or bicycle. Meaning, the fewer vehicles an individual possesses, the more inclined they are to opt for alternative means of transportation.

Concerning the second objective, a predominant view among the interviewees is that the commune lacks notable strengths. The existence of transit emerges as the secondary strength according to their perspectives. However, upon examining the weaknesses, it becomes apparent that poor transit ranks third. Consequently, residents are appreciative of its existence, but they find its quality lacking. An even greater weakness of the municipality is the absence of sidewalks and infrastructure for bicycles.

Expanding on the preferences expressed by the respondents, our research introduces a collection of seven strategies that provide ecological, social, economic, responsible and ethical benefits for public authorities, citizens and companies. These strategies encompass: enhancing road quality, improving transit systems, enhancing intersection visibility, constructing sidewalks and bike paths, implementing additional speed limiters, expanding traffic lanes and roads and refining rules and regulations.

A crucial suggestion for future research derived from the study entails the implementation of longitudinal studies to evaluate the enduring efficacy and viability of the suggested transportation solutions. Moreover, conducting additional research on the incorporation of developing technologies, such as intelligent transportation systems and electric vehicles, could yield significant knowledge on improving the effectiveness and ecological consequences of sustainable transportation programs.

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Dezvoltarea sistemelor de transport durabile: o analiză a alegerilor modale de trafic folosind managementul responsabil pentru planificarea dezvoltării viitoare

Abstract

Sectorul transporturilor exercită o influență substanțială asupra societății, cuprinzând dimensiunile economice, sociale și de mediu ale durabilității. Recunoașterea acțiunilor conștiente de mediu inițiate de indivizi, în special la nivel de bază, favorizează dezvoltarea unei identități sociale pro-mediu. Articolul își propune să analizeze sistemele de transport dintr-o perspectivă pornind de la cetățeni din cadrul unei municipalități. În consecință, trei obiective sunt propuse pentru această lucrare de cercetare: investigarea comportamentului cetățenilor în ceea ce privește transportul, evaluarea punctelor forte și punctele slabe ale comunităților pe baza perspectivelor cetățenilor și generarea de idei pentru îmbunătățirea tranzitului prin principii de management responsabil folosind o abordare de jos în sus. S-a constatat că îngrijirea privată este cel mai des utilizat mod de transport. Numărul de mașini este singura variabilă care influențează alegerea transportului. S-a identificat o relație pozitivă semnificativă între numărul de mașini și călătoriile cu mașina, în timp ce s-a observat o relație negativă între numărul de mașini și călătoriile cu tranzit, pietoni sau biciclete. Pe lângă aceasta, au fost determinate și alte relații semnificative. În ceea ce privește cel de-al doilea obiectiv, majoritatea intervievaților percep că comuna nu are puncte forte semnificative. În ceea ce privește oportunitățile de îmbunătățire, respondenții își exprimă dorința deîmbunătățire a infrastructurii pietonale și pentru bicicliști, a facilităților de tranzit și de a adăuga mai multe benzi și drumuri.

Cuvinte cheie

Mobilitate verde; trafic; transport durabil; dezvoltare durabilă; management responsabil.