***IBIMA Publishing***
*Journal of Eastern Europe Research in Business and Economics*
*http://ibimapublishing.com/articles/JEERBE/2024/714661/*
*Vol. 2024 (2024), Article ID 714661, 8 pages, ISSN: 2169-0367*
*https://doi.org/10.5171/2024.714661*

*Research Article*

# The Impact of Transport Costs on Business Decision-Making in Rural Areas

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Received date:29 March 2023; Accepted date: 6 September 2023; Published date: 15 October 2024

Academic Editor: Frantz Daniel Fistung



**Abstract**

Mobility challenges in rural areas can have a negative impact on economic and demographic development. People in these areas often have to move to urban areas to find quality jobs or services, which can lead to a decline in population, and economic activity. In this paper we analyze the factors influencing business decisions in rural areas. Public transport infrastructure based on short energy cycles using solar energy represents a solution to boost business decision management in rural areas.

**Keywords:** solar energy, public transport, business, rural

## Introduction

Addressing this problem by providing affordable and accessible public transport could have a positive impact on economic and demographic development in rural areas. This would make it easier for people to find jobs in nearby towns and cities without having to commute, which could help increase population, and economic activity (Hörcher and Tirachini 2021; Lunke 2020; Saif, Zefreh, and Torok 2019). The availability of public transport is also one of the factors that would positively influence investment decisions in rural areas, could attract investment to rural areas, creating new jobs, and boosting the local economy (Bondemark et al. 2021; Khan, Hrelja, and Pettersson-Löfstedt 2021; Oeschger, Carroll, and Caulfield 2020; Przybylowski, Stelmak, and Suchanek 2021).

An accessible public transport would positively facilitate essential factors such as:

1) **Increased accessibility:** By providing public transport in rural areas, residents will have increased access to jobs, health, education,, and other essential services. This can lead to poverty reduction, and increased living standards.
2) **Economic development:** Improved transport infrastructure can attract investors, who may be more inclined to develop businesses and create jobs in rural areas, thus contributing to the

**Cite this Article as:** Tatiana CHIRIL, Oleg Filimon, Gheorghe Adrian ZUGRAVU and Cristian Simionescu (2024)," The Impact of Transport Costs on Business Decision-Making in Rural Areas, Journal of Eastern Europe Research in Business and Economics Vol. 2024 (2024), Article ID 714661, https://doi.org/10.5171/2024.714661

region's economic growth. Efficient public transport can also facilitate the development of tourism in rural areas, generating additional income for communities.

3) **Reducing migration to urban areas:** Efficient public transport in rural areas can help reduce population pressure on cities by encouraging people to stay in rural areas. This can lead to a more balanced population distribution, and more sustainable development in the long term.
4) **Attracting new residents and increasing the skills of the population:** A good public transport network can make rural areas more attractive to people who want to move there, thus stimulating population growth. This can also attract a more diverse and highly skilled, workforce to the region.
5) **Access to health services and education:** Efficient public transport can facilitate access to health services, and educational institutions, which can improve the quality of life.
6) **Stimulating the entertainment industry:** Public transport in rural areas can facilitate the development of, and access to, various entertainment events, and activities such as festivals, concerts , and fairs. This can attract tourists, and investment, contributing to the development of the local entertainment industry, and economic growth.
7) **Promoting green tourism:** An efficient and accessible public transport network can encourage green tourism in rural areas. Tourists can visit scenic spots, and nature parks without depending on personal transport, reducing emissions, and environmental impact.
8) **Preservation of cultural and natural heritage:** Rural public transport can facilitate access to historical sites, monuments, and protected areas, thus contributing to the preservation and promotion of cultural heritage.

Solar energy can contribute to solving the problem of accessibility of public transport in rural areas in the following ways:

A) Forming the ecosystem of electricity generation: Identifying the optimal short energy circuit to provide the required electricity.
B) Forming the local electric transport fleet and timetable: Identifying transport needs , and setting priorities.
C) Electric vehicle supply: Electric vehicles running in rural areas can be powered by solar energy.

A digital management solution to manage and optimize the interaction between actors in the cycle of providing rural areas with solar-powered public transport would facilitate processes, and increase interest in this area. This may include business processes, human resource activities, financial processes, logistics or any other aspect of the operation of this cycle.

The digital management solution would be a valuable tool to optimize, and automate business processes , and provide access to up-to-date , and relevant information for decision-making.

## Materials and Methods

### Factors influencing business decisions in rural areas

In different countries, different criteria are applied to assign territories to the rural area label.

For example:

- In Australia, rural territories are defined as territories outside the city where the population lives in geographical proximity (population density of at least 200 people per 1 km2) in groups of more than 1000 people;
- New Zealand, and includes out-of-center territories with a population of more than 1000 people, which in turn are divided into 'rural centres' with a population of 300 to 999 people , and other 'rural' territories;
- In Canada, these are considered to be territories with a population concentration of fewer than 1000 people, and a population density of fewer than 400 people per 1 km2;
- In Finland - a territory with a low population density, and dispersed settlement;

- In Greece - territories with a population density of fewer than 2000 inhabitants;
- In France, rural territories are defined as areas occupied by small urban municipalities (communes), and rural municipalities with a population of fewer than 2000 people;
- In Germany, the division of areas by type has been introduced according to population density, and the size of the regional centre.
- In the USA - Areas with a population of fewer than 35 thus, and people or other territories that are not included in the number of urbanised, outside territories with a developed transport system; Eurostat classifies territories based on population, and population density indicators, dividing them into narrow (mainly urban, with a population density of 300/km$^2$, and at least 5 thous, and inhabitants), intermediate, and sparsely populated (mainly rural) sizes.

The Organisation for Economic Cooperation and Development (OECD) distinguishes three types of rural territories:

- Economically integrated rural areas: - a territory with developed infrastructure, located in close proximity to towns, with a small proportion of employees in agriculture, and a fairly high level of population income;
- Transitional rural areas - the main rural territories relatively remote from cities but closely linked to them due to the availability of developed transport infrastructure, and specialisation in the production of agricultural products;
- Remote rural areas - are far from cities, distinguished by poorly developed infrastructure, low population density, depopulation. The population of these territories is characterised by low incomes. Distressed regions have the highest and on state policies aimed at developing these regions (Aldred et al. 2021; Chao et al. 2021; Neal et al. 2021).

Based on the above, we can distinguish 3 groups of businesses that characterise the 3 areas listed:

Economically integrated rural areas:

a) Economically integrated rural areas;
b) Services (beauty, bookkeeping, and consultancy, IT, etc.);
c) Real estate leasing;
d) Agricultural services:
e) Transport services;
f) Leisure;
g) Wholesale/retail trade;
h) Construction, etc.

Transitional rural areas:

a. Retail trade;
b. Transport services;
c. Consumer services;
d. Agricultural production.

Remote rural areas:

a. Agricultural production;
b. Transport services;
c. Retail trade.

From what has been reported, it is clear that there is a common element that has an impact on business decisions in rural areas, and this is the accessibility, and cost of transport services, which in turn has an influence on:

- Production, and trade costs;
- Product competitiveness;
- Staff skills;
- Ability to attract skilled personnel;
- Accessibility of raw materials;
- Ability to attract investment, etc.

If we are to investigate the possibility of developing rural areas, it is important to investigate how we can optimize transport costs, and how we can pass on control of their transport costs to the inhabitants of rural areas, which can then become an attractive lever for influencing business decisions in these areas.

- In the Republic of Moldova, all the territory is considered rural except for the municipalities of Chisinau and Balti.

Chisinau municipality - 779 339 inhabitants

Balti municipality - 127 192 inhabitants

Analyzing the statistical data on the number of MSEs for the period 2015 - 2021, we can observe the confirmation of the theory of the development of the entrepreneurial environment around Chisinau and Balti municipalities (see Figure 1).

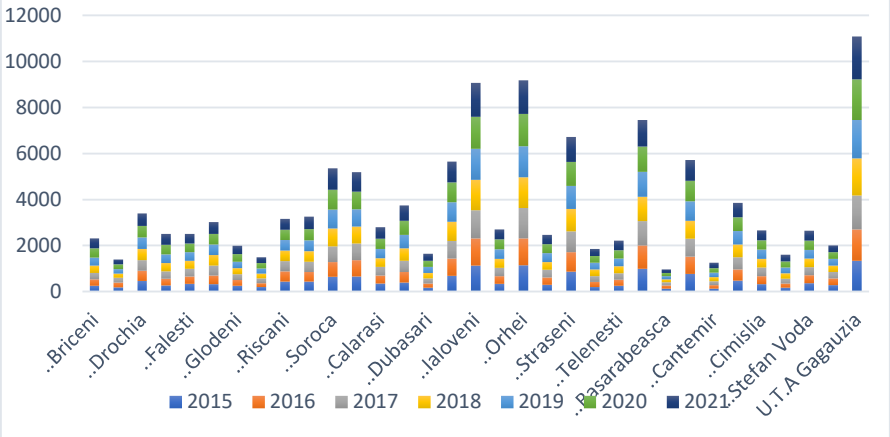


**Figure 1. Evolution of small and medium -sized enterprises from the rural area of the Republic of Moldova for the period 2015 - 2021 in territorial profile on districts**

*Source: The author of the article*

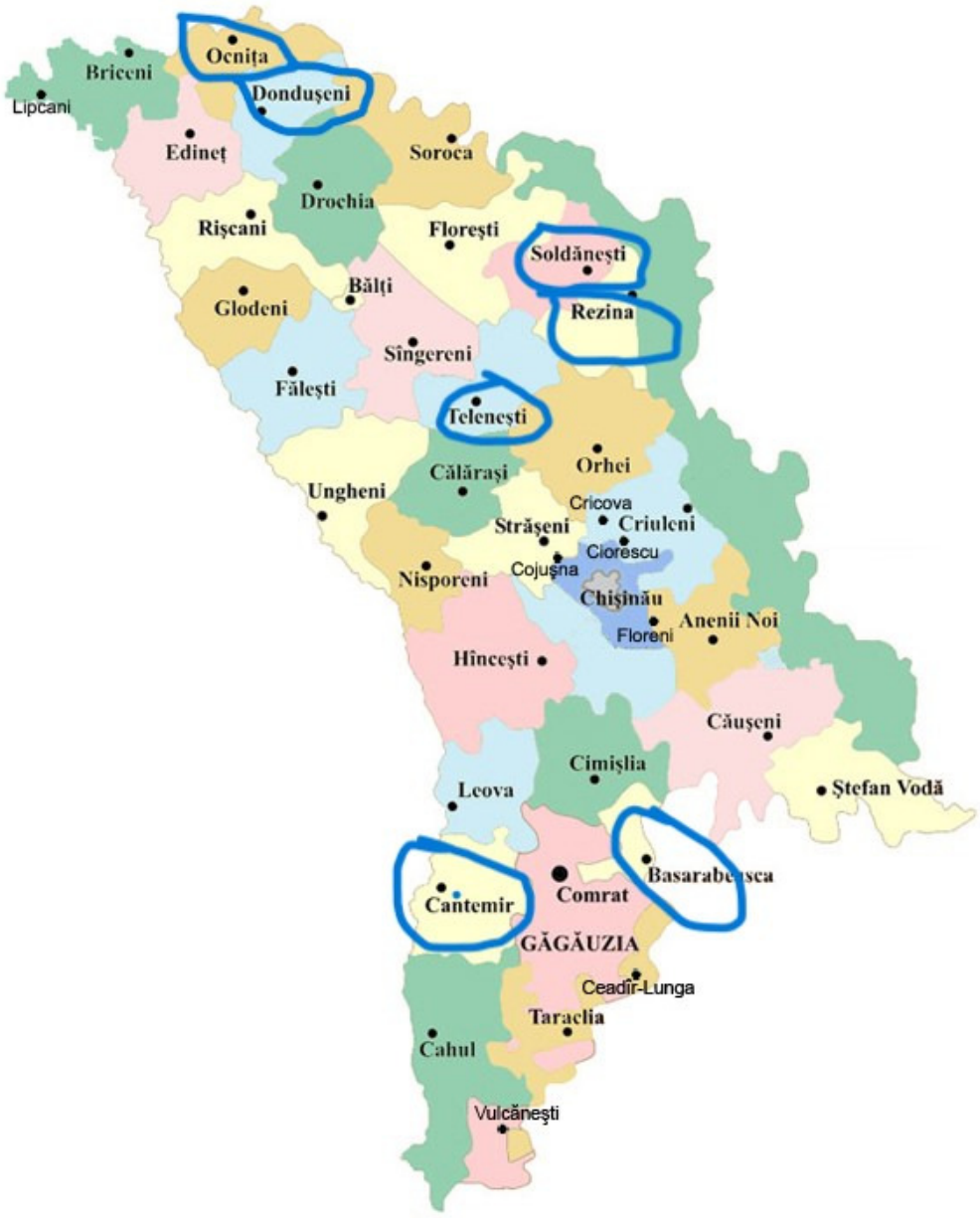


**Figure 2: Map of the peripheral districts which confirms the theory of weak development of the areas removed by the urban centres developed according to the graph in Figure 1.**

*Source: The author of the article*

After analyzing the graph and identifying the peripheral points on the map (see Figure 2), we see that the OECD study confirms the same logic , and the lowest entrepreneurial activity is recorded in the peripheral districts of the Republic of Moldova, while the districts concentrated around the municipalities of Balti and Chisinau record an increased activity. Cahul and Ungheni districts are also a special case, as they are border crossing points with Romania, which opens wider opportunities for larger markets.

**Results and Discussions**

Short-cycle energy transport infrastructure using solar energy is a solution to boost decision management in rural businesses

In order to increase the development of rural areas, it is necessary to move towards other

types of transport that contain a higher degree of innovation, and that could result in lower transport costs.

Electric buses are an alternative to traditional public transport vehicles that run on fossil fuels such as petrol or diesel. They are powered by electric batteries, and use electric motors to move.

Considering that the Republic of Moldova has no energy resources of its own, and is virtually completely dependent on fossil fuel and electricity imports, and as of October 2021, gas prices have increased significantly in the Republic of Moldova, both due to the latest developments in regional energy markets caused by the post-pandemic economic recovery, and the war in Ukraine (the purchase price of gas increased from USD 265/1000 m3 in 2021 to USD 1193/1000 m3 in April 2022, and USD 919/1000 m3 in May 2022). Unforeseen excessive price increases have caused a domino effect of rising prices in all areas, including electricity, uncertainty, and decision risks for rural businesses (Bouichou et al. 2021; Condori-Alejo, Aceituno-Rojo, and Alzamora 2021; Summers-Gabr 2020).

For a long time, energy was based on a paradigm that required electricity to be generated in centralised high-power units (located in areas determined by certain generation, and/or consumption conditions), transmitted to consumption areas via transmission lines, and delivered to consumers via a passive infrastructure at lower voltages. In this system, power flows in one direction only, from higher voltage levels to lower ones.

Modern technologies allow us to move towards new power supply models, which would significantly increase the reliability of the continuous supply process, and the predictability of the delivery price.

Locally initiated and managed, short energy cycles are a reliable solution for the RM, as they would allow the management and adjustment of expenditure to the needs of the locality, as well as having an impact on the optimisation of the public transport infrastructure in rural areas.

A short hybrid energy cycle based on solar energy, diesel generator power, and a storage battery is an energy production and distribution system that combines different energy sources to ensure an efficient and reliable supply.

This system combines renewable resources, such as solar energy, with conventional sources, such as diesel generators, and uses storage batteries to ensure continuity of energy supply.

Here's how each component works:

A) Solar power: Solar (photovoltaic) panels convert sunlight into electricity. This energy is managed and used directly by consumers/producers or stored in storage batteries for later use. Solar energy is a renewable and non-polluting source of energy, which is abundant in the country (100 - 150 W/m2).

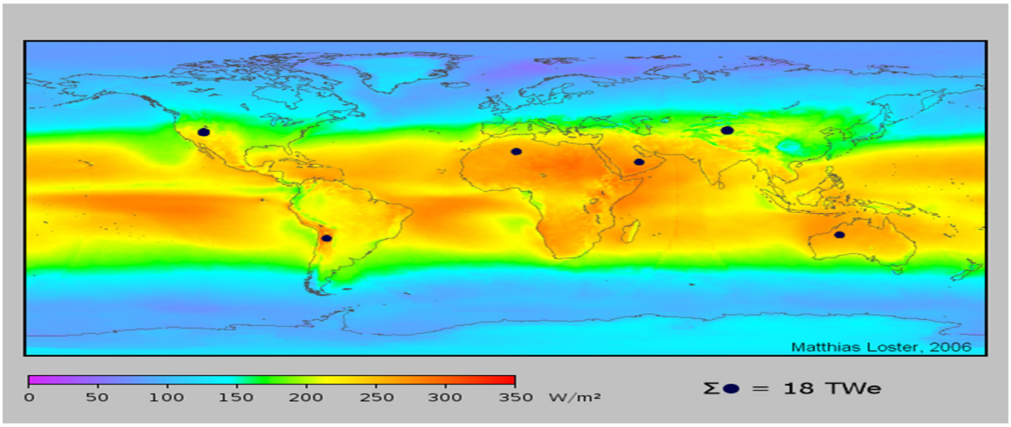


**Figure 3: World solar energy map**

Source: http://www.ez2c.de/ml/solar_land_area/

B) Diesel generator: If solar power is not sufficient to meet the energy, the diesel generator steps in to provide additional electricity. It uses diesel, a fossil fuel, to generate electricity. Diesel isn't a environmentally friendly energy source, but the diesel generator is an efficient and reliable back-up solution for balancing the flows during the dark period.
C) Accumulator storage: Accumulator storage, usually batteries, allows temporary storage of electricity produced by solar panels or diesel generators. The stored energy can then be used during periods when energy demand is greater than production, especially at night or on cloudy days.

A short hybrid power cycle combines these energy sources to ensure a continuous and efficient supply of electricity. The hybrid system adapts according to energy availability, and, primarily using solar power, and resorting to diesel generators and storage batteries if solar power is not sufficient. This hybrid system helps reduce dependence on fossil fuels while promoting stability and energy efficiency.

As a result, a local municipality can cooperate with citizens to form a short energy cycle by placing solar batteries on the roofs of houses, which would contribute to the collective provision of cheaper public transport.

A digital management solution would enable the formation of an energy cycle with tracking, and setting of optimal operating parameters.

**Conclusions**

In conclusion, we can mention that optimising decision management in rural businesses can be achieved by combining strategic, innovative, and sustainability-oriented approaches. These can include adapting to the specific needs of rural communities, integrating emerging technologies, and addressing social issues.

Here are some suggestions for optimising decision management in rural business:

1. Market analysis and knowledge of community needs: Identifying the needs of the rural community is essential for making informed decisions, and developing appropriate strategies. This involves monitoring trends, and changes in the environment, and collecting, and analysing relevant data.

2. Integrating emerging technologies and innovation: Adopting new technologies and innovative solutions can increase the efficiency and competitiveness of rural businesses. For example, the use of information and communication technologies (ICT) and, renewable energy systems can help to optimize processes, and improve services.

3. Partnership development, and collaboration: Collaboration with other organisations, institutions , and local authorities can help identify opportunities , and develop synergies. Partnerships can facilitate access to information, resources, and funding, as well as the sharing of knowledge and experience.

4. Community involvement and transparent communication: Engage and communicate with the local community by identifying mutual benefits.

A short-cycle PV-based model could impact rural transport costs by promoting electric vehicles powered by photovoltaic (PV) systems, and reducing reliance on fossil fuels. This model would involve installing solar-powered charging stations for electric vehicles in rural areas, and using PV to power transport infrastructure.

Impacts on transport costs could be seen in the following areas:

1. Reducing fuel costs: By using solar energy to power electric vehicles, the costs associated with purchasing and transporting fossil fuels could be significantly reduced.
2. Reduced maintenance costs: Electric vehicles have fewer moving parts than internal combustion engine vehicles, leading to lower long-term maintenance costs.
3. Government incentives and tax breaks: Governments could provide financial incentives for the purchase of electric vehicles, and the installation of solar-powered charging stations, reducing overall costs for consumers.
4. Increased energy autonomy: By using solar energy instead of fossil fuels, rural communities can benefit from greater energy autonomy, which can lead to overall cost savings.

A digital tool for public transport management in rural areas based on the short energy cycle **would be advisable**, and could be built in this way:

- ✓ Installing solar photovoltaic systems: By installing solar photovoltaic panels on the houses of village residents, the construction date can provide a clean and reliable source of energy for public transport in rural areas.
- ✓ Implementing an electricity-based public transport management system: This system could include software to manage charging and use of electric vehicles, management of consumption by producer partners and planning and monitoring of public transport routes.
- ✓ Internet connectivity of all system components: All system components, including electric vehicles and charging stations.
- ✓ Integration with other systems: The public transport management system could be integrated with other systems, such as electronic payment systems or public transport applications, to provide a simpler and more accessible user experience.

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