Katarzyna Anna **KUŹMICZ** • Urszula **RYCIUK** •
Ewa **GLIŃSKA** • Halina **KIRYLUK** • Ewa **ROLLNIK-SADOWSKA**

# PERSPECTIVES OF MOBILITY DEVELOPMENT IN REMOTE AREAS ATTRACTIVE TO TOURISTS

Katarzyna Anna **Kuźmicz** (ORCID: 0000-0002-6897-0375)
Urszula **Ryciuk** (ORCID: 0000-0001-6410-9601)
Ewa **Glińska** (ORCID: 0000-0002-2121-0125)
Halina **Kiryluk** (ORCID: 0000-0001-6137-4418)
Ewa **Rollnik-Sadowska** (ORCID: 0000-0002-4896-1199)
*Bialystok University of Technology, Faculty of Engineering Management*

Correspondence address:
Wiejska Street 45A, 15-351, Bialystok, Poland
e-mail: k.kuzmicz@pb.edu.pl

ABSTRACT: This paper addresses the problem of transport systems in remote areas, defined by a set of constraints deriving from a sparse population, infrequent transportation location means stops and cost-effectiveness of the system. Remote areas attractive to tourists additionally require transportation services designed with respect to changeable demand and the necessity to provide transportation solutions limiting detrimental influence on the environment. This paper aims to identify and assess the perspectives for developing innovative mobility solutions for residents and tourists in remote areas in line with sustainable development and evaluate factors supporting or hindering the development of the selected perspectives. The results of a Delphi study with 23 experts from seven EU Member States, Russia and Norway, enabled identification of factors shaping the future of mobility in peripheral areas, including IT-supported multimodal transport systems, demand-responsive transport and transport services tailored to the specific needs of different user groups.

KEYWORDS: innovative mobility solutions, sustainable mobility, transport policy, remote areas attractive to tourists, Delphi method

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## Introduction

Planning passenger transportation in areas with changeable demand for transportation services with peaks in tourist seasons and low demand periods during the remaining part of the year, where mainly inhabitants of the region use transport services, is a challenging task. The sparsely populated region with infrequently distributed stops of transport means enforces tailor-made solutions with transport on demand or at least based on through calculation of the demand to avoid the unnecessary cost of providing services for a few or no passengers. Such a problem mainly tackles depopulating areas where the concept of mobility as a service with community-driven platforms improves accessibility and livability of the area (Geurs et al., 2018).

Mobility planning in regions under special environmental protection, which is often the case in tourist destinations, requires innovative solutions reducing the detrimental impact on the environment, such as alternatively fueled vehicles (Tekil et al., 2022; Masmoudi et al., 2020), which is costly at the beginning of the implementation but provides returns from investment in a longer perspective.

Remote and sparsely populated areas require a special approach for their connectivity. Conventional public transportation means such as buses and trains efficiently transport a mass of travellers in busy traffic corridors. Small-sized vehicles can better serve low-density areas due to their flexibility (Yan et al., 2021). Mobility on demand systems synchronises various transit elements, such as the connection between rail and bus lines and between the line-based transit services and demand-response services (Yan et al., 2021; Errico et al., 2013; Wang et al., 2014). The system can also integrate autonomous vehicles to reduce the operation costs of transport (mainly driver cost) and facilitate communication and coordination among the vehicles (Buehler, 2018). Autonomous vehicles are also environmentally friendly.

Research interest in innovation, sustainable transport and sustainable mobility has been growing in recent years (Hoerler et al., 2019; Dziaduch, 2021; Paradowska, 2021; Fournier et al., 2018; Gil et al., 2011). However, most studies focus on urban areas, e.g. on intelligent transport systems in smart cities (Hajduk, 2021). Remote areas and rural areas receive much less attention (Soder & Peer, 2018; López-Iglesias et al., 2018; Szymańska et al., 2021; Flipo, 2021, Campisi et al., 2021; Bell & Sumper, 2015). In addition, there is little scientific contribution to transport and mobility issues in Baltic Sea Region (Berg, 2015; Nilsson, 2018; Kiryluk et al., 2021). Also, relatively little attention has been paid to the mobility of tourists at their destination (Dickinson & Robbins, 2008), while much more attention is paid to the means of transport used to travel from origin to destination (Gutiérrez & Miravet, 2016).

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In this paper, the results of the studies carried out in the course of the project MARA – Mobility and Accessibility in Rural Areas aiming to improve the accessibility and mobility in remote touristic areas of the Baltic Sea Region by increasing the capacity of transport actors are presented. The project was funded by the Interreg Baltic Sea Region Programme 2014–2020 and was performed between January 2019 and June 2021. The paper aims to present the outcomes of the research performed, particularly during the workshop "Future of mobility in remote areas", which took place on 16 April 2021 and was a part of the implementation of the MARA project. The workshop was attended by experts representing various project partners, comprising different stakeholders of mobility planning: regional planning agencies, local and regional governments, and universities from the Baltic Sea area. The regions represented in the project include Vidzeme (Latvia), Birštonas and Druskininkai (Lithuania), Zaonezhye, Karelia (Russia), Setesdal (Norway), Hajnowka district (Poland) and Ludwigslust-Parchim (Germany). These regions exemplify remote areas attractive to tourists (most of them have facilities listed on the UNESCO World Heritage Site) sharing several common challenges, such as population decline, seasonal fluctuation of the population (tourists), expensive public transport, car-dependent lifestyle and lack of using digital solutions (MARA, 2021).

This paper's objective was to identify and assess the perspectives for the development of mobility of residents and tourists in remote areas in line with sustainable development policy (using innovative solutions). Additional objective embraced evaluation of factors supporting or hindering the development of selected perspectives. This study addresses the problem of developing innovative transportation systems in remote areas, defined by a set of constraints deriving from the sparse population, infrequent location of transportation means stops, changeable demand deriving from tourist fluctuation and cost-effectiveness of the system.

In the paper, we present an overview of the literature relevant to mobility in remote areas. Issues regarding the specificity of such regions and their challenges were discussed, particularly low transport accessibility and consequently deprivation of access to certain facilities lowering the life standard, were underlined. Subsequently, we refer to innovative solutions for sustainable mobility possible to apply in such regions. Later we present the outcomes of the Delphi study, where experts evaluated the significance of the theses for the mobility of residents and tourists in remote areas as well as enabling factors and barriers to the theses realisation. The discussion of the results of the Delphi study referred to literature investigation allowed for indicating pillars shaping the future of mobility in remote areas.

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## Literature overview

### Problems in transportation in remote areas

In remote areas, individuals and communities are experiencing a number of limitations, which prove to be major impediments within the course of meeting livelihoods opportunities (Kapur, 2019). Sparsely populated areas face many challenges, including access to a limited range of education and career options, lower wages, high cost of living, lack of full-time employment opportunities, seasonality for some jobs, e.g. tourism and certain agricultural sectors (OECD, 2021). These socio-economic outcomes are often influenced by the accessibility of transport services manifested in how easily residents can access goods, services and activities (Litman, 2018). The main transportation problems of remote areas are connected with geographic isolation, lack of public transportation and poor infrastructure.

The issue of transport demand in remote areas is not specifically investigated. Transport policy seems to be tailored to urban, developed areas. Sustainable transport policy in urban areas promotes the transition to an environmentally more sustainable means of transport, such as non-motorized modes and public transport, as well as economic punishing of passenger cars, use (Jović et al., 2013).

However, remote, mainly rural areas are characterised by certain features that influence the specificity of transportation needs, which make them different from urban areas. Those specific features mainly include low population density, unfavourable demographic structure (young people are leaving because of the difficult access to educational centres and workplaces) (Pezzini, 2000; Rostami, 2005), distance from city centres, spatial scarcity of facilities and underdeveloped public transport network (or public transport does not exist).

One of the main challenges for remote areas development, especially attractive to tourists, is sustainable mobility. Sustainable mobility requires changes to the entire mobility management system. It should, in particular, aim to prevent the social exclusion of people living in remote areas and reduce the environmental damage caused by transport (Miller, 2020).

Geographically isolated regions are often dependent on air and maritime connections. However, those types of transport meet efficiency obstacles in sparsely populated areas. Airlines usually have little or no economic incentives to operate remote air services. Remote air routes often face shortages of qualified pilots and mechanics and difficulty attracting people of such professions (Tretheway et al., 2021). Similar to air transport, maritime passenger and freight transport in remote areas is affected by viability issues. That lack of sufficient demand in those types of transport in remote areas makes ser-

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vices unprofitable, providing private transport operators little incentive to maintain marginal routes.

At the same time, surface transport is limited by austerity policy in the aftermath of the 2008 economic crisis, which accelerated rationalisation and centralisation, affecting the distribution of basic services – including transport. Moreover, the disadvantage of surface transport in remote and sparsely populated areas is lower infrastructure network resilience and reliability (OECD, 2021). In some cases, this is due to high costs and a lack of funding for maintenance.

Other challenges relate to geographical barriers, the complexity of trips, climate change and seasonality of transportation links. As a result, residents of remote areas are transport-deprived and dependent on passenger cars (Pucher & Renne, 2005; Currie et al., 2009; Shergold & Parkhurst, 2010).

The low transport accessibility seems to be the main problem in remote areas. The term accessibility has several definitions. For example, in terms of economic and social opportunity, accessibility can be defined as proximity or facility for spatial interaction (Gutierrez, 2009). This also includes virtual access, which refers to the use of the Information and Communication Technologies (ICTs) as an alternative to physical mobility (e.g., e-work, e-services, e-business and e-commerce), (Kenyon et al., 2002, Kenyon et al., 2003). In the transport context, accessibility can be defined as a facility or opportunities with which basic services can be reached from a given location by using a certain transport system (Gutierrez, 2009).

Many remote areas have limited or no connection to public transport, and traditionally, as was mentioned, transport has been based on-road vehicles (Velaga et al., 2011) predominantly. The lack of transport accessibility and connectivity in remote areas strongly impacts those with limited access to private motorised transport such as children, older people, people with disabilities, and the mobility impaired (Velaga et al., 2011).

Low transport accessibility in remote areas by limitation of transport possibilities to road vehicles is caused by a low level of innovation which improves efficiency and service quality of transport systems.

Though innovative transport technologies have been widely deployed in urban and suburban areas in the developed world, their application in remote areas has been limited (Nalevanko & Henry, 2001). Potential exists for these technologies to contribute to alleviating accessibility and inclusion problems in such areas. Digital technologies are often used to make mainstream public services (such as education, health care and transport) more effective and efficient (Boulton, 2010; Ejdys & Gulc, 2020).

The ongoing process of increasing tax burdens by imposing a tax on car ownership, increasing registration fees as well as the rise of fuel prices further deprive residents of remote areas and lead them to even more signifi-

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cant transport deprivation and low transport accessibility (McNamara & Caufield 2011; Delbosc & Currie 2011). Transport deprivation may be one of the causes of the low mobility of both – residents of remote areas as well as tourists.

Most remote communities face higher costs of travel and more complex and often seasonal transportation links. Extreme weather in many remote regions, exacerbated by climate change impacts, make resilience an important issue (OECD, 2021).

Except for highly developed countries, transportation researches in remote areas have rarely been conducted (Jović et al., 2013). This is especially evident in underdeveloped countries and countries in transition. Therefore it is necessary to define a specific transport policy for remote areas to prevent social exclusion and to provide social equity of inhabitants as well as to attract tourists to those territories.

Developing policies for sustainable transport systems in remote areas is a major challenge for the future. The key issues to consider include a high level of uncertainty due to changes in, e.g., emission regulation and the development of alternative fuels and electric vehicles. Answering the challenges of climate change, regulation of $CO_2$ emissions, the urban environment are important drivers of sustainable transport development (Melander, 2018).

The European Commission and most European Union countries want Europe to become climate neutral by 2050 (European Commission, 2018; Dębkowska et al., 2022). Aiming to realise this aim, it is assumed in the European Green Deal to reduce greenhouse gas emissions from transport by 90% by 2050.

The key element of The European Green Deal as far as an EU transport policy is concerned is accelerating the shift to sustainable and smart mobility. It involves providing users with more affordable, accessible, healthier and cleaner alternatives to their current mobility solutions. (European Commission, 2019). In 2020 European Commission issued Sustainable and Smart Mobility Strategy – putting European transport on track for the future (European Commission, 2020). The strategy points among others to:

- greening of mobility based on an efficient and interconnected multimodal transport system, zero- and low-emission vehicles;
- digital transformation and mobility automation to improve the levels of safety, security, reliability, and comfort;
- improving accessibility of mobility for all, including the better connection between rural and remote areas;
- increase mobility's resilience to crises.

Better connected rural areas (between each other and with suburban and city areas) also be one of the pillars of the long-term vision for the EU's rural areas developed in 2021 – Towards stronger, connected, resilient and

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prosperous rural areas by 2040 (European Commision, 2021). This document also sets pressure on boosting sustainable and intermodal transport as well as digitalisation.

## Innovative solutions for sustainable mobility

The concept of sustainable mobility was born out of a growing awareness of the negative impact of transport and current mobility patterns on the environment and focused on the users of the transport system (Bauchinger et al., 2021; Le Boennec et al., 2019). In recent years, the academic discussion on transport policy and transport management has increasingly replaced the term "transportation" with "mobility", which shows a shift in focus from vehicles to people (Miller, 2020).

Siefkes (2010) indicates four "e" cornerstones of sustainable mobility: energy (energy saving), efficiency, economy and ecology. According to Banister (2006), the sustainable mobility approach requires actions to reduce the need to travel (less trips), to encourage modal shift (e.g. switching from private cars to public transport or more environmentally-friendly vehicles such as electric vehicles bicycles), to reduce trip lengths and to encourage greater efficiency in the transport system. According to Thi Le (2014), sustainable mobility should not require a reduction in mobility. Still, it should be safe for all users and minimise negative effects on individuals, communities, the private sector, and the environment.

The essence and principles of the sustainable mobility paradigm are extensively described by Banister (2006), Scott, Hopkins and Stephenson (2014) and Miller (2020). Sustainable mobility in the context of rural areas was investigated, among others by Walkman et al. (2008), Shergold & Parkhurst (2010), López-Iglesias et al. (2018), Kühl (2021), and concerning tourism by Hopkins (2020).

Implementation and development of transportation services in remote areas requires innovative solutions, enabling a more sustainable and flexible approach to managing transport systems in regions. Among other things, it should consider the variability of demand for transport services, both from residents and tourists. Modern technologies will play an important role in this process. They take into account, among other things, the use of transport telematics that encompass a range of advanced computer, ICT, navigation and positioning systems and digital technologies in the field of transport (Giannopoulos, 2004; Sussman, 2005; Deeter, 2009). Examples include real-time bus arrival information at bus stops, intelligent public transport systems (such as electronic payment collection and automated vehicle scheduling), and shared flexible transport management (such as dial-a-ride share taxi services) (Politis et al., 2010). Technological innovations, especially in

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means of transport (e.g. electric vehicles, autonomous vehicles) and information and communication systems (e.g. wireless communication, geo-localisation), allow to increase transport effectiveness and efficiency (Pesch & Kuzmicz 2020), reduce its negative impact on the environment (e.g. by using alternative fuels and renewable energy sources) (Banister, 2006), and increase the competitiveness of the area as a place to live, work and relax.

Innovative transport solutions addressing the issues of sustainable mobility include, among others: vehicle sharing systems (carsharing, bikesharing) (Dalis & Amudha, 2015), ride-sharing (carpooling), multimodal transport (Keller et al., 2018), electric vehicles (Mann, 2014; Borén et al., 2017), autonomic vehicles (Akash & Kulkarni, 2021), micro-mobility and micro transit (Miller, 2020), which will facilitate a shift from private car use to (micro) public transport, thus reducing emissions, improving accessibility and preventing social exclusion (Bauchinger et al., 2021). Literature studies show that electric vehicles, autonomous vehicles and shared vehicles are among the most promising options for sustainable mobility (Subramanian & Dayakar, 2021; Mann, 2014; Webb, 2019; Anastasiadou, 2021; Schippl & Truffer, 2020).

Electricity-based mobility (EBM) refers to both Battery Electric Vehicles (BEV) and hydrogen ($H_2$) driven Fuel Cell Electric Vehicles ($H_2$-FCEV) or Synthetic Natural Gas Vehicles (SNG-V) (Rüdisüli et al., 2022). Although electric vehicles are more expensive than conventional cars, they are less harmful in terms of air and noise pollution than fossil fuel cars (Dalis & Amudha, 2015). Innovative forms of mobility concepts based on electric vehicles can not only contribute to the energy transition in a sustainable way but also better meet the needs of rural communities (Schuckmann et al., 2012). There is now a growing global political emphasis on developing innovative technologies and promoting incentives to support the use of alternative fuel vehicles (AFV) (Browne et al., 2012). However, there are many barriers to consumer adoption of alternative fuel vehicles (AFVs), including regulatory barriers, resources, infrastructure and vehicle features themselves (Byme, 2001). However, the main advantages of autonomous vehicles (AVs) include travel safety, travel time reduction, fuel efficiency, and parking benefits (Fagnant & Kockelman, 2015).

The demand for innovative technological mobility solutions has led to the development and rapid deployment of new mobility services. Public transport authorities in developed European countries have introduced the Mobility-as-a-Service (MaaS) products to assist citizens in piecing together individualised offerings that suit their travel needs (Hirschhorn et al., 2019; Smith, 2021). MaaS is here defined as a "type of service that through a joint digital channel enables users to plan, book, and pay for multiple types of mobility services" (Smith, 2020). MaaS is a novel brand of transport that

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promises to replace private cars with multimodal personalised mobility packages (Alyavina et al., 2020). The term emerged within the transport sector around 2014 (Heikkilä, 2014; Hietanen, 2014). Although the conversation initially focused mostly on urban transport problems, such as congestion, lack of parking, and excessive car use, rural MaaS has received increasing attention from both transport scholars and practitioners.

Lack of public transport service availability and efficiency can provide conditions that are highly suited to the development of more flexible, demand responsive transport services, which are often supported by transport telematics. Such services may develop more readily in social contexts notable for high levels of community involvement and support, e.g., concerns about traveller information in rural areas are leading to passengers sharing information about their journeys using the latest mobile and IT technologies through social networks, media sharing and blogging (Politis et al., 2010).

Another similar concept is integrated multimodal mobility (IMM) platforms, which idea is to provide one-stop-shop offering information, booking and payment options for multiple means of transport (Keller, Aguilar, & Hanss, 2018). A common feature of innovative mobility offers is their dependence on Intelligent Transport Systems, which users use via mobile applications on smartphones or tablets (Le Boennec et al., 2019). MaaS and IMM, as competitive alternatives to the private automobile, provide users with more flexible, convenient and integrated travel options (Goldman & Gorham, 2006). One of the key challenges for intelligent mobility in rural areas is standardised metrics for optimal routes' detection (Porru et al., 2020). New, innovative technologies and services can support sustainable mobility if they are successfully integrated into the given mobility system (Hoerler et al., 2019).

In peripheral regions, where public transport is rarely available, shared mobility should be promoted, particularly ride-sharing, including carpooling. Shared mobility is characterised by the sharing of a vehicle instead of ownership, as well as the utilisation of technology to connect users and suppliers (Santos, 2018). Carpooling is defined "as the sharing of short- or long-distance car rides between people who are not members of the same household, for a trip (or part of a trip) already scheduled by the driver, free of charge or expense sharing" (Aguiléra & Pigalle, 2021).

Private forms of carpooling can help to combine car trips and reduce emissions. However, research by Kühl (2021) shows that car sharing is considered a useful option only when trips are made with friends and is more feasible for leisure mobility (Kühl, 2021). In areas with low transport demand, the feasibility of implementing on-demand forms of transport would need to be assessed, particularly DRT (Demand Responsive Transport) (Campisi et al., 2021; Knierim & Schlüter, 2021). In small inaccessible towns, the likeli-

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hood of using, for example, on-demand buses increases with age, suggesting that DRT systems benefit a doubly constrained population, namely the older population in towns with few public services (Knierim & Schlüter, 2021; Broome et al., 2012). Automated demand responsive transport services are perceived as disruptive technologies in the transport markets (Grunicke et al., 2021).

Orienting remote areas towards sustainable mobility requires an appropriate transport policy and planning approach in the regions. In this process, it is important to create and model scenarios (Banister, 2006; Keseru et al., 2021) to draw attention to major challenges and organise different stakeholders' cooperation. Sustainable passenger transport policies are most often directed towards everyday travel and ignore the large and expanding amount of tourism travel (Holden & Linnerud, 2011).

## Methodology and problem setting

The research presented in this article was based on one of the expert methods, the Delphi method. This method was developed at the RAND Corporation in the 1950s under the auspices of the U.S. Air Force as a technique to apply expert input in a systematic manner using a series of questionnaires with controlled opinion feedback (Linstone & Turoff, 2011). It can be defined as a structured group communication process to ensure the effectiveness of a community of independent people who, as a whole, tend to solve a complex problem (Linstone & Turoff, 2002). This method allows gathering data from a panel of selected experts as the information will be more credible than that of a single expert (Marchais-Roubelat & Roubelat, 2011; Curiel-Esparza et al., 2016).

The key features of Delphi include multi-stage procedure, anonymity, providing feedback, independence of experts' views (Kononiuk et al., 2021). Delphi method assumes at least a repeated survey of the same group of experts (Kowalewska & Głuszynski, 2009). This technique improves the efficiency of the dynamic process of the panel of experts (Curiel-Esparza et al., 2016).

In the case of research carried out for this article, the Delphi method was treated as an expert study in which intuitive expert opinions are treated as a legitimate contribution to formulating a vision (scenario) of the future on a research subject (Nazarko, 2013).

Currently, Delphi is widely used in various research fields, including but not limited to areas such as health, defence, business, education, information technology, transport and mobility (Skulmoski et al., 2007; Szpilko, 2014). However, the use of the Delphi method in transportation and mobility research is not very common. A systematic literature review conducted by

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Melander (2018) on the use of the Delphi in developing scenarios for the future of transportation identified about 20 papers published on the topic in WoS and Scopus. The topics covered in the literature review were divided into four broad themes related to transport: logistics, mobility, future developments of technologies and environmental issues. However, none of the articles dealt with transportation and mobility in remote areas attractive to tourists.

This article fills a research gap in using the Delphi method to identify directions of mobility improvement in remote areas attractive to tourists.

## Development of the theses

In the classical approach, the Delphi study is preceded by the formulation of Delphi theses or projections and ancillary questions. The Delphi theses refer to the future description of dependencies between issues arising from the field of the study and a setting determined by the goal of the research carried out. Ancillary questions can include items such as, among other things: the level of expert knowledge, factors conducive to the realisation of the thesis, barriers to its implementation (Radziszewski et al., 2016). Since the development of Delphi theses highly influences outcomes validity and reliability, the authors follow strictly methodological rigour (Schuckmann et al., 2012).

The purpose of developing the theses was to describe foreseeable future directions of mobility improvement in remote areas attractive to tourists up to the year 2040. The process of development of the theses (Figure 1) began with a detailed review of the literature on transport and mobility in remote areas attractive to tourists. During the formulation of theses, the expertise gained through the participation of the authors in the MARA project was used. After developing a list of 25 theses, two internal online workshops were held, during which the list was limited to 7 theses through discussion and exchange of knowledge between authors. Then the list was provided for the MARA project leader with a request for possible corrections and suggestions for changes. After taking into account the comments of the MARA leader, the final list of 7 theses on directions of mobility improvement in remote areas attractive to tourists with a perspective beyond the year 2040 was prepared.

In general, the theses cover seven important trends prevailing in the literature review on the topic as well as in the outcomes of the MARA project (Figure 2).

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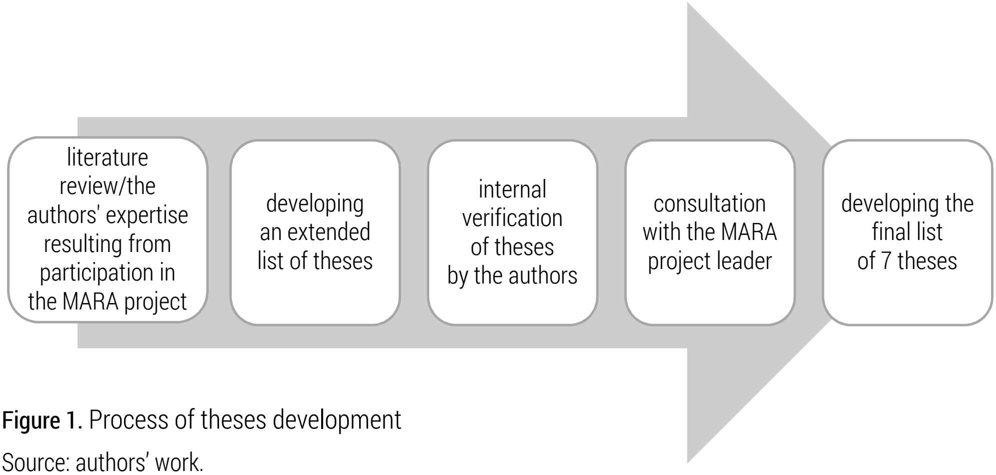


**Figure 1.** Process of theses development

Source: authors' work.

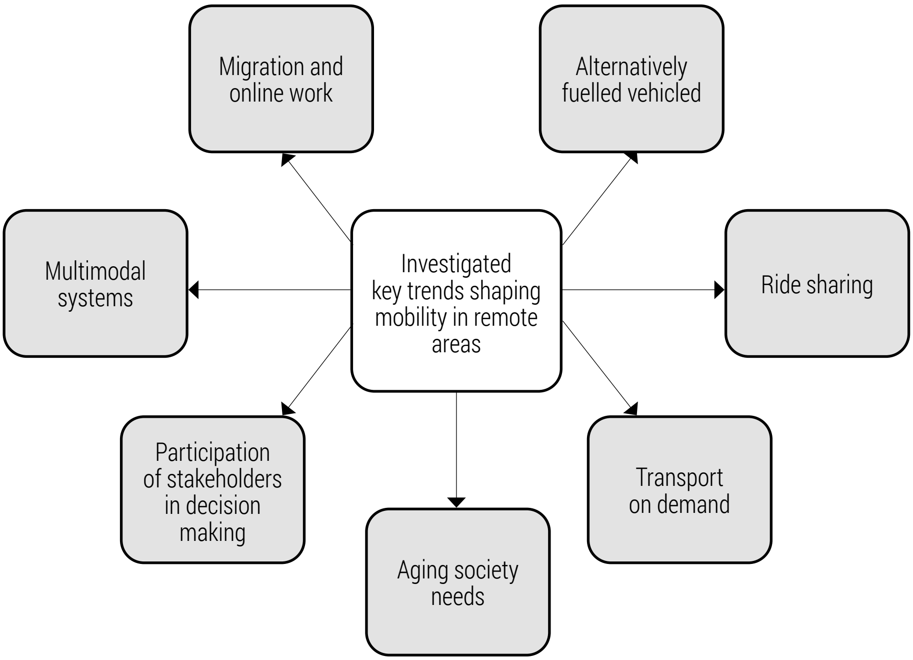


**Figure 2.** Investigated key trends shaping mobility in remote areas

Source: authors' work.

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The final list of the theses is presented in Table 1.

Table 1. Delphi theses

| Symbol of thesis | The final formulation of the thesis |
|---|---|
| T1 | The concept of ride-sharing will be less relevant in the future with the preference of individual transport (e.g. the influence of the pandemic Covid-19) |
| T2 | Increased online work opportunities and migration of people to remote areas can change mobility patterns |
| T3 | Demand-responsive transport (DRT) and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas |
| T4 | Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints |
| T5 | Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas |
| T6 | Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms) will improve mobility in remote areas |
| T7 | Public policy intensifying cooperation of authorities at local, regional and national level in transport planning will improve transport infrastructure development |

Source: author's work.

The explanation and justification of the theses are the following:

**Thesis 1.** *The concept of ride-sharing will be less relevant in the future with the preference of individual transport (e.g. the influence of the pandemic Covid-19)*

The concept of sharing economy was blooming before the Covid-19 pandemic. Still, the fight against virus spreading and the necessity of social distancing brought a turn in this trend and even a discussion whether it will restore after the pandemic (Wang et al., 2021). With the rising number of infections, some people became reluctant to share vehicles and turned to individual transport. It is not always possible due to economic reasons as it depends on the transport possibilities both individual and in terms of the local transport network. Weill et al. (2020) observed that social distancing responses to Covid-19 emergency declarations vary by income level of the region: wealthier areas decreased mobility significantly more than poorer areas. A similar hypothesis was investigated by Wee and Witlox (2021), assuming that the risk of the infection deters users from shared means of transportation. This thesis was aimed to investigate how much the pandemic can influence the trend of ride-sharing in the analysed areas.

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**Thesis 2.** *Increased online work opportunities and migration of people to remote areas can change mobility patterns*

The pandemic brought changes in the working system. Online work was recommended by the governments or enforced in lockdown periods. This became a temporary solution for some professions, but it turned out that it is a way to cut costs on offices and still bring expected results. At the same time is well perceived by the staff members because it offers them more flexibility.

European Parliament indicates that online working facilitates remote and distributed work, contributing to a more balanced spatial distribution of employment and population (Samek Lodovici et al., 2021). There is a wide recognition that the big scale of online work following the pandemic will contribute to a long-lasting impact on the spatial distribution of work, also in peripheral geographical locations, including areas across borders (ILO, 2016). They also underline the positive influence of online work on the environment and society, such as stress reduction, positive environmental impacts due to a decrease in traffic congestion and carbon emissions, and savings in terms of commuting time and costs.

The observed trend to leave the city and move to village areas to benefit from such a lifestyle while working online for the companies located in the cities became visible and also reflected in the change of prices of properties with a relative increase in village areas and decrease in the cities (Samek Lodovici et al., 2021; Delventhal et al., 2021; Gupta et al., 2021; OECD, 2020). Moving people to rural areas changed mobility patterns; new inhabitants have new needs, for example, increasing the number of children commuting to school. Therefore, this thesis has been investigated and how relevant this phenomenon can be for mobility solutions analysed.

**Thesis 3.** *Demand-responsive transport (DRT) and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas*

The widely scattered population in remote areas does not generate sufficient demand to make local public transport economically viable, traditionally organised in fixed routes and served by big buses (Li & Quadrifoglio, 2010; Knierim & Schlüter, 2021). Knierim and Schlüter (2021) investigated the reasons and preferences of people in rural areas using demand responsive transport (DTR). They point out that people without car access are more likely to use DRT systems because they may see them as improving their individual mobility situation. They also indicate that mobility-related physical impairment of the transport service users favours the DTR. Changeable demand in tourist and non-tourist periods is a factor encouraging for DTR solutions, especially in the time of lower demand. Providing services for tourists requires tailor-made solutions reflecting tourists preferences and demands.

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**Thesis 4.** *Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints*

Aging society is a problem under consideration worldwide. According to the United Nations Department of Economic and Social Affairs Population Division, older people comprise more than one-fifth of the population in 17 countries today, and they predict that in 2100 this will be the case for 155 countries, covering a majority (61%) of the world's population (United Nations, 2019). There were 703 million persons aged 65 years or over in the world in 2019. The number of older persons is projected to double to 1,5 billion in 2050. Globally, the share of the population aged 65 years or over increased from 6% in 1990 to 9% in 2019 and is projected to rise further to 16% by 2050. This means that one in six people in the world will be 65 years or older, which substantiates thinking about older adults' transportation needs very seriously.

In terms of transportation services, dial-a-ride solutions served by minibuses driving older adults to healthcare institutions, shopping, leisure activities etc. dominate. Dial-a-ride services may have different options of passenger transfers from one vehicle to another, considerations of assistance manpower requirements, multiple service providers cooperating in one area (Tekil et al., 2022; Masmoudi et al., 2020). Door-to-door service is required, and vehicles need to be equipped with entrance facilitating devices space for mobility aids for the elderly: wheelchairs, crutches, walkers. The organisation of on-demand minibuses for the elderly population proves to be especially effective in less developed regions (Liu et al., 2021). Since the problem of an aging society is rising (Jarocka & Wang, 2018), elderly people have become a substantial group for transport service providers. Therefore it was investigated how relevant it is to address this group's needs in transport planning in remote areas.

**Thesis 5.** *Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas*

The rising awareness of the catastrophic influence of human activity on the environment and unavoidable climate change solutions for alternatively fueled vehicles raise a lot of attention. In order to accelerate the adoption of low-emission vehicles, governors and academics focus on financial incentives or technological advancements that might decrease purchase prices (Schlüter and Weyer, 2019; Egbue & Long, 2012), increase vehicle range (Greaves et al., 2014) or improve the charging infrastructure (Lieven, 2014). The preferences and attitudes of users are rarely considered, although Schlüter and Weyer (2019) point out that these might be decisive barriers to change and introducing sharing of electric cars may partially reduce the users' doubts. The financial barrier often remains the most influential in

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many regions. However, considering that the analysed areas are under the special protection of the surrounding nature, it seems that they are particularly suitable for the use of electric or hydrogen vehicles; hence the relevance of this thesis has been established for the experts' consideration. Borén et al. 2017 provide a sustainable vision for electric vehicle systems on the example of southeast Sweden with a view to 2030.

**Thesis 6.** *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms) will improve mobility in remote areas*

Based on the literature review and the outcomes of the MARA project, it can be stated that multimodal transport systems integrating rural shared mobility services with public transport services seem very important. Mounce et al. (2020) indicate the main requirements for such an integrated system: the capability of the existent transport services to become integrated; necessary physical infrastructure to support interchanges; necessary digital infrastructure and connectivity to exchange the needed information, e.g. about service delays; the willingness of stakeholders to exchange information and to make compromises if necessary, e.g. in terms of altering timetables to facilitate speedy interchanges. Multimodal transport systems highly facilitate transport flow both in freight and passenger transportation reducing the time and resources needed to transfer from one means of transport to another (Kuźmicz & Pesch, 2017; Kuźmicz & Pesch, 2019). Passengers expect mobile applications integrating all transport means and one ticket for all transport possibilities, including additional services such as parking. Bike and scooter rentals because an important element of the first and last-mile transportation, especially providing transportation on remote stretches, so their integration into a multimodal system seems vital.

**Thesis 7.** *Public policy intensifying cooperation of authorities at local, regional and national level in transport planning will improve transport infrastructure development*

The development of transportation services in rural areas has a great value for its inhabitants, increasing the quality of their lives and giving them a chance to make up for some deficits. Some lack access to services offered in the cities. To a large extent, diminishing these differences has been funded by the European Union. However, these subsidies have decreased in recent years as part of a wider reduction by the central government on public spending (Mounce et al. 2020). The effective distribution of financial resources depends on the decision-makers. The more centralised is the system, the lower the level of inhabitants or tourists satisfaction. Therefore it is important to

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increase the level of engagement of local stakeholders. Providing this thesis considering intensifying cooperation of authorities at the local, regional and national level as a means of improvement of mobility has been an attempt to check whether the experts see this area as a chance for a real improvement.

## Experts selection

Former research demonstrated that choosing appropriate experts for Delphi studies significantly influences the reliability of research results (Schuckmann et al., 2012). In selecting the panel for the Delphi study needs to be stressed, not only for finding a heterogeneous group willing to participate but also to consider their context, background, location and expertise (Melander, 2018). There are different approaches to select Delphi experts, one of them is to invite experts who took part in former studies and projects on the topic or by networking with professionals etc. (Piecyk & McKinnon, 2010).

**Table 2.** The structure of Delphi experts

| Country | Name of the organisation | Category of stakeholders | Number of experts |
|---|---|---|---|
| Estonia | University of Tartu | university/academia | 1 |
| Finland | Finnish Environment Institute SYKE | university/academia | 1 |
| Germany | Ministry for Energy, Infrastructure and Digitalisation Mecklenburg-Vorpommern | local or regional government | 2 |
| Latvia | Vidzeme Planning Region | regional planning institution | 3 |
| Lithuania | Vilnius Gediminas Technical University | university/academia | 2 |
| Norway | Bygland Municipality | local or regional government | 1 |
| Norway | Agder Kollektivtrafikk AS | local or regional government | 1 |
| Poland | Bialystok University of Technology | university/academia | 4 |
| Poland | Transport consulting company | business | 1 |
| Poland | Hajnówka County | local or regional government | 3 |
| Russia | Petrozavodsk City Administration | local or regional government | 1 |
| Sweden | Dalarma Univeristy | university/academia | 1 |
| Sweden | Trafikverket | government agency | 2 |

Source: author's work.

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In this case, 23 experts from the MARA project representing seven EU member states, Russia and Norway, took part in the study. Among them, representatives of different stakeholders groups were included, such as regional planning institutions (13%), regional and local governments (34%), universities/academia (39%), government agencies (9%) and businesses (4%) from the Baltic Sea Regions, including Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia, and Sweden (Table 2).

Firstly, the experts participating in the Delphi research were asked to evaluate their knowledge related to mobility in remote areas on a scale from 1 to 5, where 1 means the knowledge is „very low" and 5 means that the knowledge is „very high". 75% of experts declared that their level of knowledge is "high" or "very high", 25% of experts indicated their level of knowledge related to the issue of mobility in remote areas as „average" and none as „low" or „very low".

## The procedure of conducting the Delphi study

The Delphi survey was conducted during the workshop "Future of mobility in remote areas", which took place online on the Zoom platform on 16 April 2021 and was part of the implementation of the MARA project.

The authors applied an Internet-based Delphi variant, which uses real-time logic and reduces the length of time required to conduct the survey (Schuckmann et al., 2012). The Internet-based Delphi method is particularly useful when experts are geographically dispersed and unable to meet as one group (Melander, 2018). Nowadays, Delphi studies use the Internet to distribute questionnaires (Szpilko, 2014).

The experts participating in the Delphi research, firstly, were asked to evaluate their knowledge relating to mobility in remote areas on a scale from 1 to 5, where 1 means the knowledge related to mobility in remote areas is „very low" and 5 means that the command is „very high".

Next, the experts were asked to assess seven future theses/projections (listed in Table 1). The experts evaluated the significance of the thesis for the mobility of residents and tourists in remote areas in two rounds. The assessment was made on a scale from 1 to 5, where 1 means the importance of the thesis is „very low" and 5 means „very high". The second round of assessing the significance of theses was preceded by an open discussion over the evaluation results of each thesis obtained in the first round.

In the next stage, experts assessed the impact of the contributing factors and the barriers on the feasibility of the thesis.

In the last part of the survey, experts gave the opinion about the estimated time of realisation of theses. The implementation time of theses was evaluated by selecting one of the three responses: "before 2030", "in years 2030-2040", and "after 2040".

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The significance ($Si$) of the theses for the mobility of residents and tourists in remote areas were assessed according to the formula (based on Kononiuk et al., 2021):

$$S_i = \frac{100*n_{VH}+75*n_H+50*n_A+25*n_L+0*n_{VL}}{n}, \quad (1)$$

where:

$n_{VH}$ – the number of responses “very high”,

$n_H$ – the number of responses “high”,

$n_A$ – the number of responses “average”,

$n_L$ – the number of responses “low”,

$n_{VL}$ – the number of responses “very low”,

$n$ – the number of responses.

In the next stage, experts assessed the impact of the contributing factors and the barriers on the feasibility of the thesis. The contributing factors ($C$) indicators and the barriers ($B$) indicators were calculated according to formula (2) and formula (3), respectively (based on Kononiuk et al., 2021).

$$C = \frac{100*n_{VH}+75*n_H+50*n_A+25*n_L+0*n_{VL}}{n}, \quad (2)$$

$$B = \frac{100*n_{VH}+75*n_H+50*n_A+25*n_L+0*n_{VL}}{n}. \quad (3)$$

## Outcomes

The research was divided into two stages. The experts evaluated the significance of the thesis for the mobility of residents and tourists in remote areas in two rounds. The results obtained from the first round of the Delphi method are presented in Figure 3.

The indicators of thesis significance were determined according to the formula (1) and ranged from 50.0 to 85.2 (Table 3).

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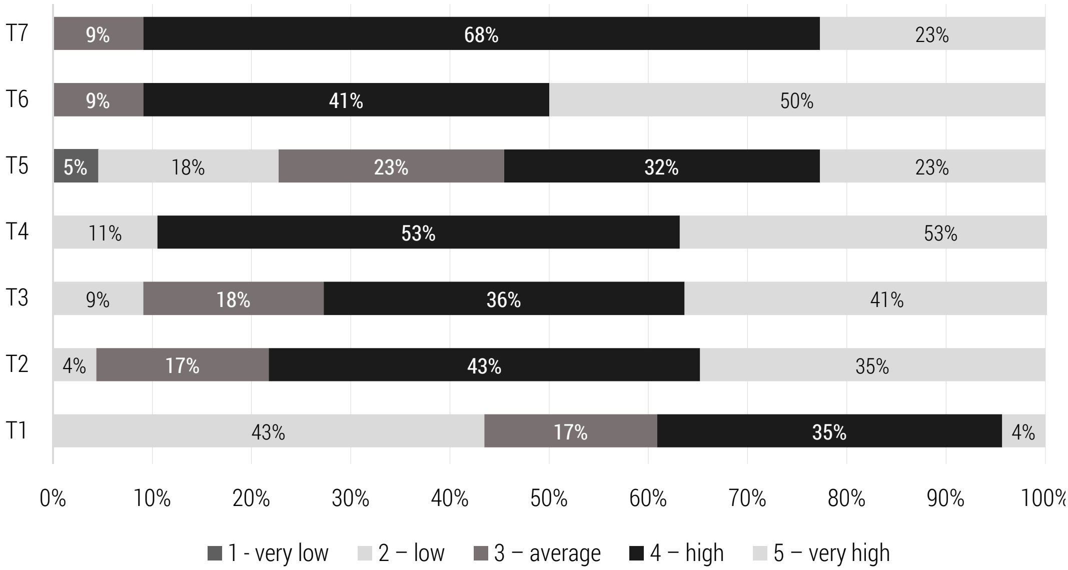


**Figure 3.** The significance of the theses for the mobility of residents and tourists in remote areas – experts' opinions (1st round)

Source: authors' work.

**Table 3.** Indicators of the significance of the theses for the mobility of residents and tourists in remote areas – 1st round results

| Thesis | Indicators of the thesis significance (SI) |
|---|---|
| T1 | 50.0 |
| T2 | 77.2 |
| T3 | 76.1 |
| T4 | 81.8 |
| T5 | 62.5 |
| T6 | 85.2 |
| T7 | 78.4 |

Source: authors' work.

Analysing the results, it should be indicated that in experts' opinion, the theses that are the most significant for the mobility of residents and tourists in remote areas are thesis T6 – *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms)* will improve mobility in remote areas, and thesis T4 – *Dynamically aging society will*

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*increase demand for special transportation solutions for the needs of people with mobility constraints*. The significance indicators of those theses exceeded the value of 80, and the importance of the thesis for the mobility in remote areas was assessed as “very high” by more than 50% of experts. The thesis of the lowest value of significance indicator is thesis T1 – *The concept of ride--sharing will be less relevant in the future with the preference of individual transport (e.g. the influence of the pandemic Covid-19)*. For 43% of respondents, the significance of that thesis is “low”.

In the next stage, experts assessed the impact of the contributing factors and the barriers on the feasibility of the thesis. Among contributing factors were considered: (C1) Additional financial support; (C2) Fast development of technologies connected with sustainable transport solutions; (C3) Increased involvement of stakeholders in local transport policy; (C4) Raising of public environmental awareness and (C5) Increase of tourist interest in remote areas. The barriers examined are as follows: (B1) Limited funding; (B2) Legal restrictions on protected areas; (B3) Changeable demand for transport services (tourist seasonality); (B4) Lack of social acceptance; and (B5) Lack of digital competences. The values of contributing factors (C) and barriers (B) indicators were calculated according to the formula (2) and formula (3) (Table 4 and Table 5).

**Table 4.** Indicators of the impact of the contributing factors on the feasibility of the theses

| Thesis | Additional financial support (C1) | Fast development of technologies connected with sustainable transport solutions (C2) | Increased involvement of stakeholders in local transport policy (C3) | Raising of public environmental awareness (C4) | Increase of tourist interest in remote areas (C5) |
|---|---|---|---|---|---|
| T1 | 51.3 | 62.5 | 56.6 | 48.8 | 58.8 |
| T2 | 50.0 | 80.0 | 53.8 | 53.8 | 61.3 |
| T3 | 71.3 | 80.0 | 73.8 | 60.0 | 63.2 |
| T4 | 76.4 | 69.7 | 65.8 | 40.8 | 38.2 |
| T5 | 76.3 | 88.2 | 50.0 | 68.4 | 61.8 |
| T6 | 76.3 | 82.9 | 68.4 | 52.6 | 69.7 |
| T7 | 64.5 | 56.6 | 82.9 | 55.3 | 63.2 |

Source: authors’ work.

According to the experts’ opinion, “additional financial support” is the factor contributing the most to the feasibility of the thesis T4 – *Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints*, thesis T5 – *Deployment of electric*

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*and hydrogen vehicles will dominate transport in remote nature-valuable areas,* and thesis T6 – *Multimodal transport systems supported by integrated schedules and ticketing system as well as digitalisation will improve mobility in remote areas* – the value of contributing factors (C) indicators are 76.3-76.4. The next factor, "fast development of technologies connected with sustainable transport solutions", contribute the most to the feasibility of the thesis T5, formulated as *Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas* (indicator value is 88.2). At the same time, it is the most important factor (with the highest indicator value in the study) among all the factors in the analysis. "Fast development of technologies connected with sustainable transport solutions" is highly evaluated also in the case of thesis T6 (indicator value – 88.2) and theses T2 and T3 (indicators value – 80.0). "Increased involvement of stakeholders in local transport policy" is of the greatest meaning in case of the thesis T7 (indicator value – 82.9) stated as *Public policy intensifying cooperation of authorities at local, regional and national level in transport planning will improve transport infrastructure development*. In turn, "Raising of public environmental awareness", according to the experts 'opinion, is the factor contributing the most to the feasibility of thesis T5 (indicator value – 68.4) while "Increase of tourist interest in remote areas" to the feasibility of thesis T6 (indicator value – 69.7).

A summary of respondents assessment of the barriers to the feasibility of the thesis is presented in Table 5. The values of indicators vary in the range from 30.3 to 77.6.

**Table 5.** Indicators of the impact of the barriers on the feasibility of the theses

| Thesis | Limited funding (B1) | Legal restrictions on protected areas (B2) | Changeable demand for transport services (tourist seasonality) (B3) | Lack of social acceptance (B4) | Lack of digital competencies (B5) |
|---|---|---|---|---|---|
| T1 | 56.3 | 47.5 | 61.3 | 48.8 | 47.5 |
| T2 | 41.3 | 40.0 | 55.0 | 51.3 | 58.8 |
| T3 | 72.5 | 44.7 | 70.0 | 42.5 | 55.0 |
| T4 | 76.3 | 30.3 | 51.3 | 44.7 | 61.1 |
| T5 | 75.0 | 46.1 | 52.6 | 40.8 | 42.6 |
| T6 | 77.6 | 43.4 | 59.2 | 50.0 | 63.2 |
| T7 | 67.1 | 43.4 | 55.3 | 40.8 | 31.6 |

Source: authors' work.

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According to the experts, the first barrier, "Limited funding", seems the most significant affecting too much extent to the feasibility of all investigated thesis. The barrier is of the greatest importance for thesis T6, assuming that *Multimodal transport systems supported by integrated schedules and ticketing systems as well as digitalisation will improve mobility in remote areas* (indicator value – 77.6) and of the least importance for thesis T2 – *Increased online work opportunities and migration of people to remote areas will change mobility patterns* (indicator value – 41.3). Whereas the second barrier, "Legal restrictions on protected areas", is of the least importance, not impacting the feasibility of the theses remarkably – the barrier limits the most the implementation of the thesis T1 – *The concept of ride-sharing will be less relevant in the future with the preference of individual transport*. The indicator value, in that case, is 47.5. The barrier "Changeable demand for transport services (tourist seasonality)", in the experts' opinion, limits the most the realisation of the thesis T3 – *Demand-responsive transport (DRT) and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas* with the indicator value 70.0. "Lack of social acceptance" is considered by experts as not strongly limiting the execution of all theses. The indicators values range from 40.8 in the case of thesis T5 and T7 to 51.3 in the case of thesis T2. The last barrier, "Lack of digital competencies", was evaluated as the most hindering the realisation of the thesis T6 and T4. The thesis T6 is formulated as *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms) will improve mobility in remote areas,* and the thesis T4 as a *Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints*. The indicators values are 63.2 and 61.1, respectively.

In the next part of the study (the second round of the Delhi method), the experts evaluated the significance of the thesis for the mobility of residents and tourists in remote areas for the second time. An open discussion on them preceded the assessment of the significance of theses. The results obtained from the second round of the Delphi method are presented in Figure 4 (experts opinion in scale from 1 to 5, where 1 means the importance of the thesis is „very low" and 5 means „very high") and Table 6 (the indicators of thesis significance determined according to the formula (1)).

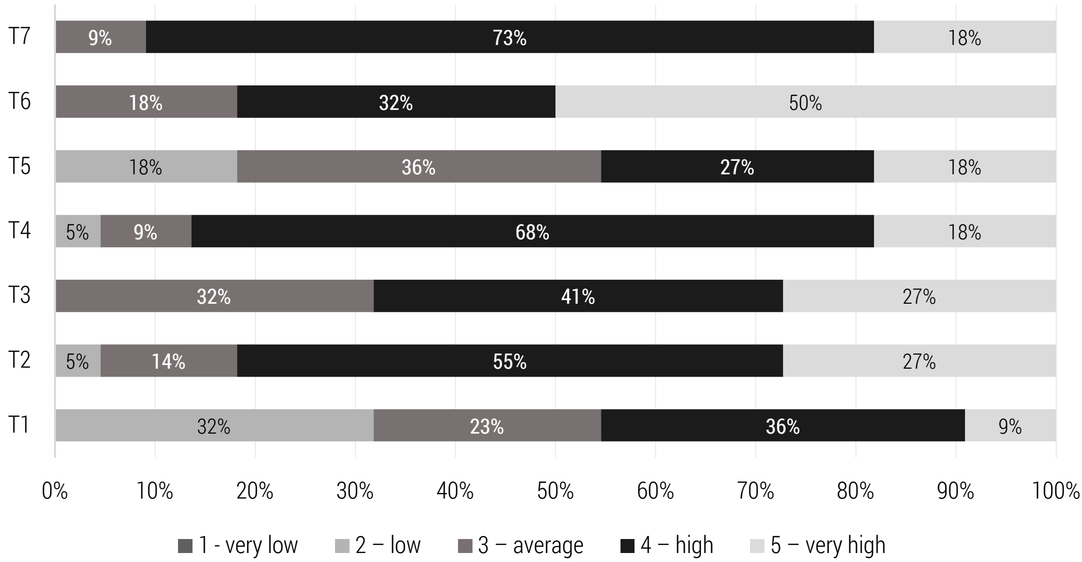


**Figure 4.** The significance of the theses for the mobility of residents and tourists in remote areas – experts' opinions (2nd round)

Source: authors' work.

**Table 6.** Indicators of the significance of the theses for the mobility of residents and tourists in remote areas – 2nd round results

| Thesis | Indicators of the thesis significance (SII) | Change in comparison to 1st round |
|---|---|---|
| T1 | 55,7 | 5,7 |
| T2 | 76,1 | -1,0 |
| T3 | 73,9 | -2,2 |
| T4 | 75,0 | -6,8 |
| T5 | 61,4 | -1,1 |
| T6 | 83,0 | -2,3 |
| T7 | 77,3 | -1,1 |

Source: authors' work.

The second round Delphi research results show that the experts, first of all, changed the assessment of the significance of the thesis T4 – *Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints* and thesis T1 – *The concept of ride-sharing will be less relevant in the future with the preference of individual transport*. However, worth stating is that, in the opinion of experts, the thesis T1 is still of the lowest value of significance for mobility in remote

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areas. The significance of the thesis, besides thesis T1, is lower than in 1st round. However, the changes in indicators values for thesis T2, T5 and T7 are not high. However, the thesis T6 formulated as *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms)* is still the most significant for the mobility of residents and tourists in remote areas. The significance of the thesis was assessed as "very high" by 50% of respondents and "high" by 32% of experts. As theses of secondary importance for the mobility in remote areas (assessed by experts on a similar level – indicators value around 73.9-77.3), should be mentioned thesis T2, T3, T4 and T7.

In the last part of the survey, experts gave the opinion about the estimated time of realisation of theses. The implementation time of theses was evaluated by selecting one of the three responses: "before 2030", "in years 2030-2040", and "after 2040" (Figure 5).

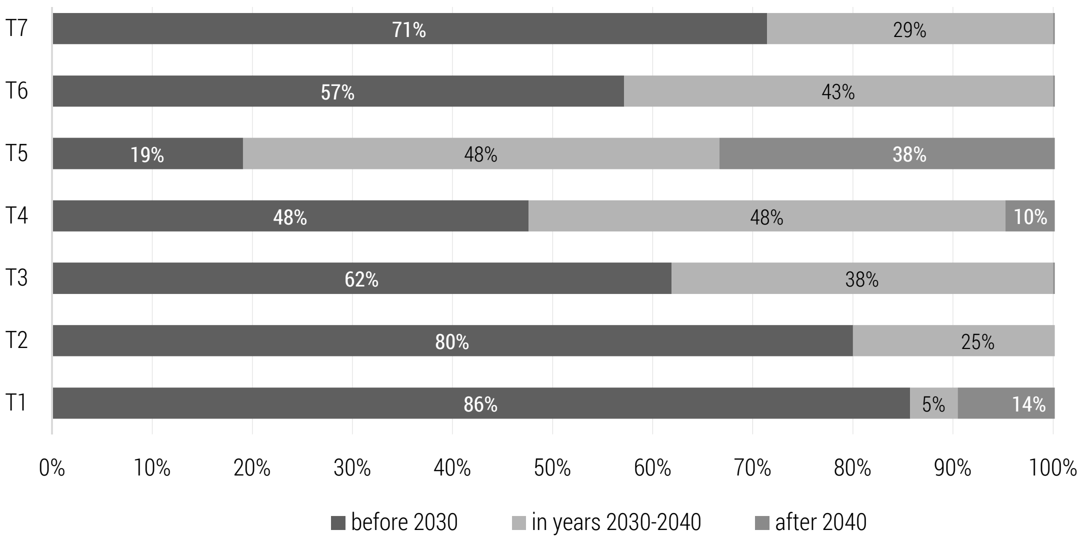


Figure 5. Estimated time of the theses realisation for the mobility of residents and tourists in remote areas

Source: authors' work.

The theses with the shortest realisation time are T1 and T2. According to experts' opinion, the chance of realising those theses before 2030 is around 80%. The dominant opinion about the estimated implementation time for theses T3, T6 and T7 is also before 2030. However, the respondent opinions are not so unified – more than 50% of experts believe that the theses will re before 2030, but another assume that in years 2030-2040 (around 30-40%

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of experts) or even later – after 2040 (in the opinion of 5% of respondents). The thesis T5 – *Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas* is estimated by experts as the thesis that will be realised in the most distant perspective – in years 2030-2040 or even after 2040.

## Discussion

The development and implementation of sustainable mobility solutions in remote areas attractive to tourists are challenging and require elaborating an innovative and flexible approach to managing the region's transport system. The research results indicate that the most significant in improving the mobility of residents and tourists in remote areas is a multimodal transport system supported by integrated schedules and ticketing system as well as digitalisation (Figure 6). Multimodal transport systems integrate different transport services, public and private, typical for densely populated as well as sparsely populated areas. The best solution should be supported by mobile applications and Internet platforms or even one ticket for all transport possibilities. Such a conclusion supports Mounce et al. (2020), who indicates integration as a pivotal requirement for the transport system.

According to our study, the estimated time for the possible introduction of multimodal transport systems in remote areas is before the year 2030 or 2030-2040. The most meaningful factor contributing to the feasibility of this thesis is the fast development of technologies connected with sustainable transport solutions and additional financial support.

Solutions of Demand Responsive Transport should reinforce the multimodal transport systems development supported by mobile applications and Internet platforms. The research shows that DRT and tailor-made travel solutions will be a significant transport element in sparsely populated remote areas in the near future (in experts' dominant opinion before the 2030 year). It is consistent with Li and Quadrifoglio (2010) research and Knierim and Schlüter (2021) explaining no economic rationale for traditionally organised, fixed public transport in remote areas. The DRT is also a good solution to ensure a connection with traditional transport systems (e.g. rail or busses), which is pointed out by Yan et al. (2021), Errico et al. (2013) or Wang et al. (2014). The most significant for DRT solutions is the fast development of technologies connected with sustainable transport solutions and increased involvement of stakeholders in local transport policy.

The necessity is the compliance of transport systems with solutions dedicated to the special needs of elderly people, people with mobility constraints and people who migrate from more densely populated to remote areas and work online. The dynamically aging society will increase demand for special

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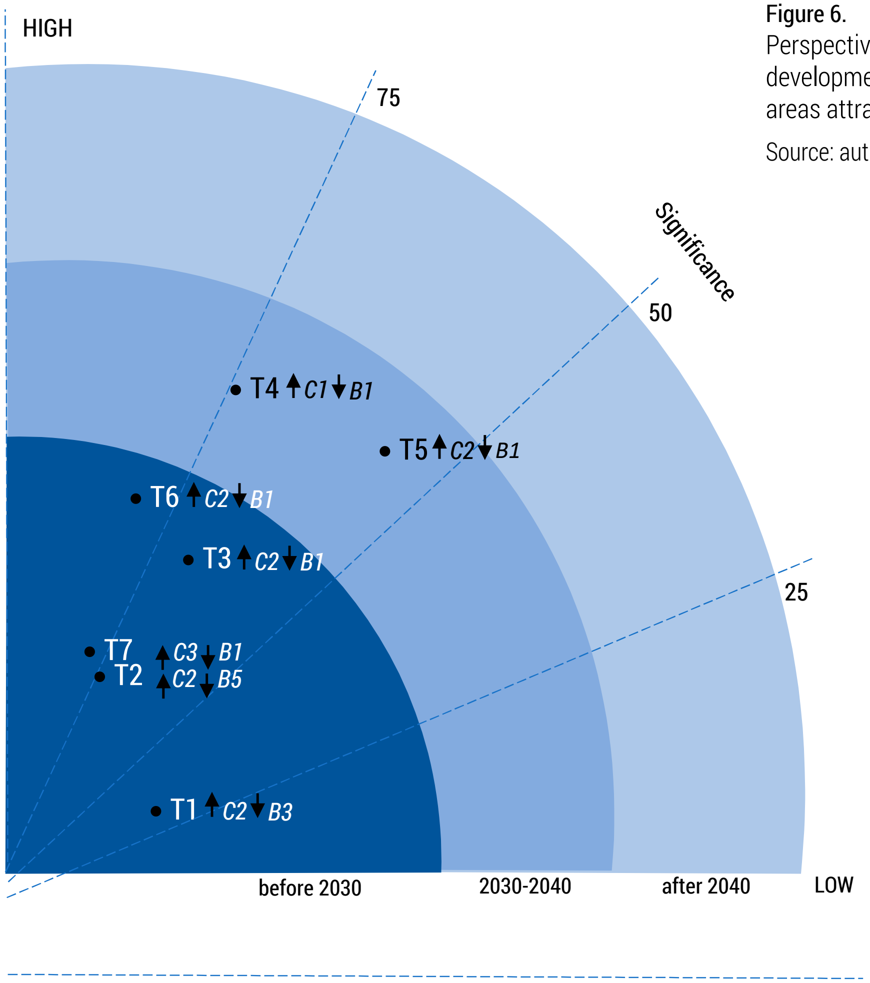


**Figure 6.**
Perspectives of mobility development in remote areas attractive to tourists

Source: authors' work.

Legend:

T1 – The concept of ride sharing will be less relevant in the future with the preference of individual transport
T2 – Increased online work opportunities and migration of people to remote areas can change mobility patterns
T3 – Demand-responsive transport and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas
T4 – Dynamically aging society will increase demand for special transportation solutions for the needs of people with mobility constraints
T5 – Deployment of electric and hydrogen vehicles will dominate transport in remote nature-valuable areas
T6 – Multimodal transport systems supported by integrated schedules and ticketing system as well as digitalisation will improve mobility in remote areas
T7 – Public policy intensifying cooperation of authorities at local, regional and national level in transport planning will improve transport infrastructure development
↑ Main contributing factor
C1 – Additional financial support
C2 – Fast development of technologies connected with sustainable transport solutions
C3 – Increased involvement of stakeholders in local transport policy
↓ Main barrier
B1 – Limited funding
B3 – Changeable demand for transport services (tourist seasonality)
B5 – Lack of digital competences

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transportation solutions with a high probability before 2030 or in the years 2030-2040. The predictable barriers for developing solutions explicitly dedicated to the needs of elderly people are limited funding and a lack of digital competencies. Some possible answers for that trend are dial-a-ride services (served, for example, with minibuses). This conclusion is coherent with Liu et al. (2021), who demonstrated the effectiveness of such a solution in less developed regions, Yan et al. (2021), who underline flexibility of such solutions and Knierim and Schlüter (2021), who pointed out that the likelihood of using buses on-demand increases with people's age. Additionally, the movement of people from big cities to the village areas is observed. The observed trend was strengthened in times of the Covid-19 pandemic that brought increased emphasis on remote work and, what is important, allowed to discover the advantages and reduce the concerns arising from such a solution. The mobility solution in remote areas must take into account the need of such a group of society because, according to experts' opinion, the chance of realising this thesis before the year 2030 is more than 80%. The perceived factors contributing to the migration of people to remote areas and changes in mobility patterns are mainly the fast development of technologies connected with sustainable transport solutions and the greatest predictable limitation – the lack of sufficient funding for the development of dedicated mobility solutions.

The introduction of new mobility solutions in remote areas should entail integrated actions and a broad perspective in transport planning and supporting decisions regarding various transport initiatives. This perspective should assume authorities cooperation on a local, regional and national level. The increase of local stakeholders engagement and its impact on mobility solutions in their region will improve transport infrastructure development, answering the needs of local residents and tourists. The conducted research shows that if stakeholders involvement in local transport policy increases and financial support is to be assured, the estimated implementation time for the thesis will be before the year 2030.

Individual car transport is less important for mobility increase in remote areas attractive to tourists. Surprisingly despite social distancing due to the pandemic and many people reluctant to close contact with other people, the experts didn't see the trend of ride-sharing as less relevant in the future. The research also shows that the deployment of electric and hydrogen vehicles is of lower relevance for mobility than other analysed issues. It can be assumed that it is due to the fact that, like points, Velaga et al. (2011), the lack of transport accessibility and connectivity in remote areas has a strong impact on those with limited access to private motorised transport, so for such groups as children, older people, people with disabilities etc. other solutions are needed. Moreover, sustainable mobility should be not only environmentally and economically but also socially friendly.

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Limited funding and changeable demand for transport services related to peaks in times when there are many tourists in the region and low demand periods when the tourist mobility is very limited appeared to be the most significant barriers to the realisation of the analysed theses. Funding resources are indisputable obstacles to developing transportation systems, and in rural, sparsely populated places, it is probably even more evident, as funding often concentrates in big cities. In the areas investigated in the MARA project, the differences between a tourist and non-tourist seasons are significant, therefore the bigger challenge in transport services planning. This problem is clearly visible in forecasting income and cost of functioning of the transport system. It is vital for resource allocation planning; for example, in planning drivers employment, much higher demand in the tourist season and much lower at the other time. The same applies to planning the needed number of transport vehicles and their effective usage. The impact of a change in demand in the transport network correlates with the change in the cost of travel (e.g. fuel costs, fares). This barrier was considered especially significant for the realisation of the Thesis 3 Demand-responsive transport (DRT), and tailor-made travel solutions will dominate in shaping the future of transport in sparsely populated, remote areas that are, in fact, is, disputable. It is hard to say that variable demand is a barrier to DTR solutions; it should be rather understood that DRT is a solution helping to overcome this barrier as it involves adjusting service frequency to clients' needs. This barrier was assessed as relevant also for Thesis 1 – *The concept of ride-sharing will be less relevant in the future with the preference of individual transport (e.g. the influence of the pandemic Covid-19)* and Thesis 6 – *Multimodal transport systems (including public transport, bike and scooter rentals, ride-sharing, taxis and parking solutions) supported by integrated schedules and ticketing system as well as digitalisation (e.g. mobile applications, ride-sharing platforms) will improve mobility in remote areas)*. Both of the theses are significant components of transport system planning providing solutions or means of transport, and therefore changeable demand makes it more challenging.

## Conclusions

This study embraces the identification of the perspectives for mobility development in remote areas in line with sustainable development policy. The conducted literature analysis showed that there is a great demand for studies supporting remote areas in the development of sustainable transport and mobility (Barfod, 2018).

Following the experts' opinion, the improvement of mobility in remote areas can be obtained by the popularisation of multimodal transport systems supported by integrated schedules and ticketing system as well as digitalisa-

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tion. In the opinion of experts, another important perspective for mobility development, which will dominate in shaping the future of transport in sparsely populated, remote areas, is demand-responsive transport and tailor-made travel solutions. The majority of experts also claimed that a dynamically aging society would increase the demand for special transportation solutions for the needs of people with mobility constraints. However, the above perspectives are strongly determined by the fast development of technologies connected with sustainable transport solutions and accessibility to the funding possibilities. Furthermore, a crucial perspective of transport infrastructure development in remote areas is intense public policy cooperation of authorities at a local, regional and national level. An important contributing factor for that perspective realisation is the increased involvement of stakeholders in local transport policy. The real improvement can be achieved through learning from best practices (Kuzmicz, 2015) and observation of the important trends both in transport and social aspect.

The contribution of this study is mainly filling the gap in the literature on mobility planning in remote, sparsely populated areas attractive to tourists. Planning a transport system answering to the challenges of such specific areas with sharp variability in demand in tourist and non-tourist periods, meeting the expectations of both residents and tourists, low density of stops of transport means and high level of significance of environmentally friendly solutions is troublesome. In this paper, perspectives of the development of mobility solutions in these regions are indicated together with contributing and hindering factors as well as time horizons.

The limitations of this study are related to the specificity of the method used. As the Delphi method strives to reach a consensus on a number of issues, it may lead to less innovative ideas than other methods (Melander, 2018). The Delphi method has its limitations, such as the use of non-randomized samples, subjectivism and bias imposed by the composition of the expert panel, and the lack of commonly accepted recommendations regarding the number of participants, rounds, the way of defining the consensus (Głuszek, 2021). Furthermore, as this method strives to reach a consensus on several issues, it may lead to less innovative ideas than other methods (Melander, 2018). Another limitation stems from the fact that only seven theses were included in the Delphi study. Indeed, additional theses relevant for the future of mobility development in remote areas attractive to tourists could be addressed. Nevertheless, the number of projections was narrowed to such a small number to increase data validity by ensuring low survey fatigue (Schuckmann et al., 2012).

It is worth noting that experts taking part in the study represent a broad array of expertise and experience in transport planning in remote areas of the regions attractive to tourists in the Baltic sea regions. Their practical and

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academic background allowed the identification of pillars shaping the future of mobility in remote areas. The next step for continuing research on the topic could be conducting the STEEPVL analysis and elaboration of scenarios of mobility solutions development specific to remote areas. The elaboration of scenarios would be preceded by an in-depth analysis of factors influencing mobility development in remote areas and an evaluation of their significance and uncertainty (Nazarko et al., 2017). Important direction is also the construction of optimisation models considering the above constraints. The issues of variable demand, meeting the needs of various groups of users young -expecting hi-tech solutions and elderly with their low digital competencies as well as integration of the different means of individual and group transport means supported by green technologies should gain special attention and comprises a rich research field to explore.

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## The contribution of the authors

Katarzyna **Anna Kuźmicz**: conceptualisation, literature review, development of the Delphi tool, conducting Delphi study, discussion of the results, conclusions, writing – original draft, review and editing (25%)

Urszula **Ryciuk**: conceptualisation, development of the Delphi tool, data acquisition and analysis, discussion of the results, conclusions, writing original draft (24%)

Ewa **Glińska**: conceptualisation, development of the Delphi tool, methodology, conclusions, writing original draft (17%)

Halina **Kiryluk**: conceptualisation, literature review, development of the Delphi tool, conclusions, writing original draft (17%)

Ewa **Rollnik-Sadowska**: conceptualisation, literature review, development of Delphi tool, conducting Delphi study, conclusions, writing original draft (17%)

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