Strategic Planning of Integrated Public Transport and Demand-Responsive Transport Systems Through PESTEL, SWOT, TOWS Analyses: The Case Study of Enna

Tiziana Campisi[1(✉)], Chiara Spadaro[1], Antonio Russo[1], Guilhermina Torrao[2], and Giovanni Tesoriere[1]

[1] Department of Engineering and Architecture, University of Enna Kore, 94100 Enna, Italy
tiziana.campisi@unikore.it

[2] Department of Engineering Management, Aston University, Birmingham B4 7ET, UK

Abstract. Today, the planning of public transport systems must pay greater attention to growing and emerging contexts such as peri-urban areas, which are characterised by low demand, complex topography and socio-territorial fragility. Indeed, these areas require in-depth study, starting with the development of analytical tools capable of supporting evidence-based strategic decisions. Within this framework, this study analyses the potential for integration between local public transport (LPT) and demand-responsive transport (DRT) services through the combined application of three different types of analysis: PESTEL (Political, Economic, Social, Technological, Environmental, Legal), SWOT (Strengths, Weaknesses, Opportunities and Threats) and TOWS (Threats, Opportunities, Weaknesses and Strengths).

These techniques are adopted as a method for understanding the main external factors affecting a transport service (political, economic, social, technological, environmental and regulatory) and as tools to support strategic planning. The methodological approach is applied to the case study of the city of Enna, in southern Italy, an urban context representative of Italy's inland areas, characterised by significant topographical variation, discontinuous settlement patterns and marked inequalities in accessibility between different urban zones.

The results obtained from the three-step analytical process indicate an effective decision-support tool for various categories of stakeholders: indeed, for service operators, this approach provides operational guidance for optimising service provision and improving economic efficiency; for local authorities, it provides a structured basis for defining integrated mobility policies and for the effective allocation of public resources; for citizens, it translates into improved access to essential services, greater territorial equity and a higher overall quality of the public transport system. This research therefore contributes to the preliminary development of more inclusive, resilient and sustainable mobility models, particularly in urban contexts within inland areas.

Keywords: PESTEL · SWOT · TOWS · Integrated transport service PT-DRT · Accessibility · Mobility Plan and Design

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1 Introduction

The evolution of public transport in suburban and peri-urban areas is shifting away from a rigid traditional model, based on fixed timetables and infrequent services, towards more flexible, smart and sustainable systems, which are essential for ensuring accessibility and reducing social isolation [1–3].

In recent years, the integration of local public transport (LPT) and demand-responsive transport (DRT) services has been increasingly established as a key strategy for addressing the challenges faced by traditional transport systems, particularly in areas characterised by low demand, scattered settlements and a growing focus on accessibility and territorial equity [4, 5].

In Italy, DRT services have mainly developed as complementary solutions to conventional public transport, often serving as a substitute or supplement in outlying areas, small towns and at times of low demand [6, 7].

In the international context, particularly in the countries of Northern and Western Europe (Germany, the Netherlands, Scandinavia), DRT is, on the other hand, increasingly seen as a stable and integral part of the public transport system [8–11].

In such cases, integration with the PT takes place at the operational, tariff and information levels, with DRT services primarily acting as feeders to high-capacity lines, supported by advanced digital platforms and established governance models [12].

Outside Europe, particularly in North America and certain parts of Asia, DRT has also developed through public-private partnerships and MaaS (Mobility as a Service) solutions, with a greater focus on operational efficiency and service scalability [13].

Initiatives in Italy, generally promoted by local or regional authorities and funded through public funds, are characterised by a strong focus on social inclusion and access to essential services, but still show a limited degree of structural integration with the PT in terms of network planning, standardised pricing and digital platforms [14, 15].

Overall, whilst international experience shows a growing maturity in the integration of PT–DRT as part of a multimodal, data-driven transport system [16], the situation in Italy reveals a more gradual evolution, closely linked to local pilot schemes and temporary funding programmes.

However, the growing uptake of Sustainable Urban Mobility Plans (SUMPs), the focus of national policies on inland areas, and the availability of European funding are key factors enabling a gradual transition towards more structured models of PT–DRT integration, in line with international best practice [17–19].

To plan and implement complementary transport services, Table 1 provides a summary of the main benefits and challenges of integrating PT and DRT services.

To plan optimal services in island contexts and inland areas characterised by low transport demand and the absence of certain transport services, this paper outlines in paragraph 2 the development of analyses targeting different stages of the planning process, which are complementary to one another, particularly in the case of designing a DRT service in Enna, namely:

- A strategic (macro) PESTEL analysis to be carried out at the initial stage of planning to analyses the external environment and thus determine whether the conditions exist for developing the service and which factors may influence it [20, 21].

Table 1. Summary of the main benefits and challenges arising from the integration of PT-DRT services

Dimension	Pros (benefits)	Cons (drawbacks)
Geographical accessibility	Extension of the service to low-density areas with complex terrain	Uneven coverage if demand is very scattered
Social equity	Improved access for the elderly, students and vulnerable users	Risk of exclusion for non-digital users
Operational efficiency	Reduction in empty runs compared to fixed-route public transport	High unit costs if demand does not reach a minimum threshold
Service flexibility	Dynamic adaptation to timetables and routes	Less predictability compared to fixed timetables
Network integration	Feeder service to the main public transport network	Need for close coordination of timetables and hubs
User experience	Booking, information and integrated travel	Complexity of the interface if not well designed
Environmental sustainability	Reduction in unnecessary kilometres and potential modal shift	Limited environmental benefits if the average load is low
Governance	Flexible tool for policies in inland areas	High administrative and contractual complexity

- A SWOT analysis at the strategic-intermediate level – i.e. following the PESTEL analysis – to assess the system's positioning (internal strengths and weaknesses, external opportunities and threats) and thus establish an overall vision for the project [22–24].
- A TOWS analysis at the strategic-operational level to define a more advanced phase, in which action is taken by combining the results of the SWOT analysis to establish concrete strategies and courses of action for the implementation of the service [25, 26].

Section 3 applies the three analyses to the case study of Enna and the proposed implementation of the DRT-PT service, thereby offering a series of considerations aimed at translating the analysis into concrete strategies applicable to the Enna case study (Sicily). The discussion and conclusions section highlights the possible strategies and tools for implementing the integrated service, providing ideas for the various stakeholders involved.

2 The Use of PESTEL, SWOT and TOWS Analysis in the Planning of Integrated Transport Services

The use of PESTEL, SWOT and TOWS analyses in the planning of integrated transport services represents a structured methodological approach to systematically addressing the complexity of the mobility sector. PESTEL analysis enables an examination of the external context (macro-environment) in which the transport system operates, considering political, economic, social, social, social, technological, environmental and regulatory factors that may influence the feasibility and development of the service.

This allows decision-makers to identify opportunities and constraints as early as the preliminary stages of planning [27, 28].

Subsequently, the SWOT analysis complements this perspective through a situational analysis: it examines factors both within and outside the system – such as available resources, operational capabilities and organizational challenges – and relates them to the opportunities and threats arising from the external environment. In this way, it provides a comprehensive overview of the integrated transport service's positioning, which is useful for guiding strategic decisions [23, 29].

Finally, the TOWS analysis enables the results of the SWOT analysis to be translated into operational strategies, combining strengths, weaknesses, opportunities and threats to define concrete actions. This step is essential for moving from the analytical phase to the decision-making and planning phase, identifying effective solutions to improve integration between different transport services [25, 30].

Overall, the combined use of these three analyses enables the development of more informed, coherent and results-oriented planning, facilitating the creation of integrated transport systems that are more efficient, sustainable and responsive to local needs.

The main differences between the three methods are summarised in Fig. 1, namely the shift from PESTEL as an integrated analysis of external factors to an analysis of factors related to the service to be planned, via SWOT analysis, and from a planning approach to a strategic one through TOWS analysis.

The application of these three approaches in planning a DRT service offers several advantages but also presents certain challenges.

Among their main strengths, these methodologies provide a structured and comprehensive overview of the context (PESTEL), enable an integrated assessment of internal and external factors (SWOT), and translate the analysis into concrete operational strategies (TOWS), thereby supporting more informed and consistent decision-making. However, they also have certain limitations, as they are often based on qualitative and subjective assessments, can oversimplify the actual complexity, and do not directly provide definitive solutions, thus requiring further investigation and quantitative analysis for effective planning. The following section outlines the main features of the PESTEL, SWOT and TOWS analyses applied to the case study, whilst also considering the evaluation of composite indicators.

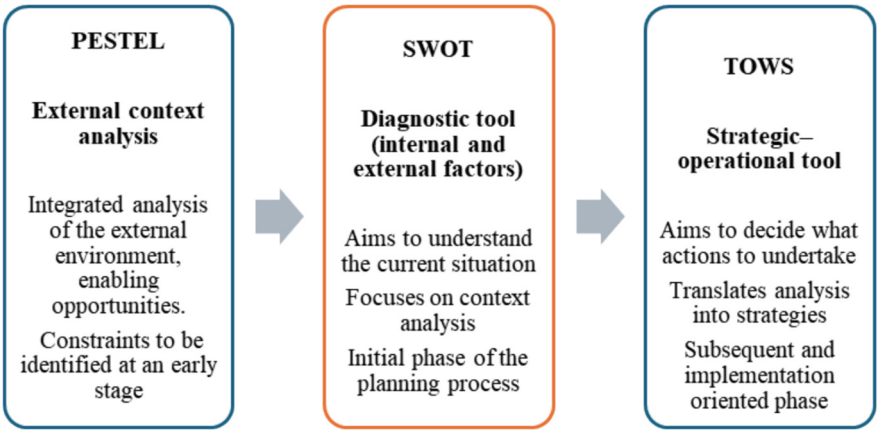

Fig. 1. Comparison of PESTEL (external analysis), SWOT (diagnosis), and TOWS (action) for the preliminary complementarity analysis between public and demand-responsive transport. The arrows indicate the evaluation process of factors, shifting from external analysis to potential actions to be implemented.

3 Methodology

The analysis begins with a brief description of the case study, before moving on to the structure of the PESTEL analysis, the identification of the four key elements of the SWOT analysis, and the identification and segmentation of the analysed context, to consider a range of parameters relevant to the strategic approach. Finally, the TOWS approach is outlined, which combines the SWOT factors to generate operational strategies.

3.1 Case Study Description

The study area analysed is the municipality of Enna, in Sicily (Italy), the location of which is shown in Fig. 2. The population living in the urban area of Enna is estimated at around 24,000–27,000, to which should be added around 10,000 commuters, comprising both workers and university students. The context of Enna is particularly well-suited to the introduction of a demand-responsive transport (DRT) service integrated with public transport, due to a combination of geographical, demographic and infrastructural factors.

The LPT in Enna is operated by a private company, providing connections between the various parts of the city, between Enna Alta (the historic centre) and Enna Bassa (the university and services area) via five urban routes. Route 3 is one of the main routes, offering a frequent service (approximately every 7–10 min). The routes cover key locations: the historic centre, Enna Bassa, the Tropea complex (Contrada Ferrante), and the Pergusa area.

Generally, the frequency of the other routes is approximately every 15–20 min on weekdays and roughly every hour on public holidays.

A free evening/night shuttle service has been in operation for about a year, connecting Enna Alta (Castello di Lombardia) with Pergusa area. It runs on certain evenings (Fridays and Saturdays) with services until 02:45, to facilitate safe travel during the nightlife. Currently, a single-journey ticket costs €1.20 and is valid for 60 min. The cost rises to €1.50 if the ticket is purchased on board. Monthly passes are available with discounts for specific groups (such as students and the elderly).

There is only one taxi service and a few private hire services, whose fares are significantly higher than those of public transport. Ultimately, public transport services today require a review and the introduction of additional systems and new timetables.

The introduction of a PT-DRT transport service can improve service provision, reduce costs and increase inclusivity, making the mobility system more effective and modern. In particular, the context of Enna offers ideal conditions for the implementation of such a service, as it is characterised by dispersed transport demand due to the complexity of its territory. It faces limitations regarding traditional transport and requires improved services in terms of accessibility.

Furthermore, as a town with a population of under 25,000 and approximately 12,000 commuters (e.g. workers and university students), it can be classified as a small-to-medium-sized town and is therefore a simpler case study to manage; where the potential integration of the service requires lower investment compared to metropolitan cities and allows for the creation of a pilot scheme that can be replicated elsewhere.

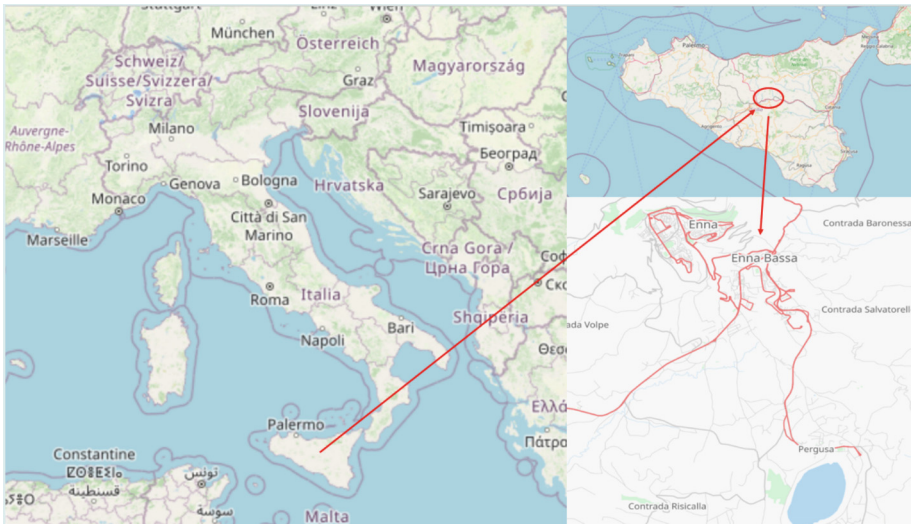

Fig. 2. Map of Italy highlighting Sicily with two zoomed-in insets of the Enna area (Enna Alta, Enna Bassa, and Pergusa). Red lines connect the main map to these detailed sections, showing the local road network and geographical context.

3.2 PESTEL Analysis

A PESTEL analysis can tangibly improve the planning of an integrated DRT–PT service in Enna because it enables stakeholders to anticipate constraints, capitalise on opportunities and adapt the project to the real-world context, thereby avoiding theoretical solutions that are difficult to implement. Its value is particularly evident when it is translated into operational decisions, as the following practical examples demonstrate.

From a political perspective, PESTEL enables the identification of existing funding instruments and strategic guidelines. For example, if Enna Council secures regional or European funding for sustainable mobility, it can design the DRT from the outset as an integrated and innovative service, thereby increasing the likelihood of obtaining resources. In practical terms, this could mean launching a funded pilot project, rather than an implementation entirely funded by the council budget.

From an economic perspective, the analysis helps to design a sustainable service. In a context such as Enna, where some bus routes are underused, PESTEL enables these inefficiencies to be identified and replaced with on-demand services. A concrete example is the reorganisation of evening or suburban routes, switching from fixed routes to DRT, resulting in reduced operating costs and better utilisation of vehicles.

As regards social aspects, the PESTEL analysis enables the service to be tailored to the actual needs of the population. In Enna, for example, the large number of elderly users suggests that the service should not rely exclusively on digital apps. A practical decision resulting from this analysis is the introduction of a dedicated telephone number for bookings, making the service accessible even to those who do not use smartphones.

On the technological front, the analysis helps to select solutions appropriate to the context. Rather than adopting complex and costly systems, Enna could initially implement a simple booking management platform, gradually integrating it with more advanced systems. This approach reduces the risk of technological failure and facilitates acceptance of the service.

From an environmental perspective, the PESTEL framework guides planning towards sustainable solutions. For example, DRT can be designed to reduce empty runs and limit the use of private cars in underserved areas, thereby helping to reduce emissions. In practice, low-demand zones can be identified where DRT completely replaces traditional services.

Finally, from a legal perspective, the analysis helps to prevent regulatory obstacles. For example, checking the constraints of public transport service contracts in advance allows conflicts between operators to be avoided by designing a coherent integration. A practical application is the definition of an integrated fare model, which allows users to use DRT and buses with a single ticket.

In summary, the PESTEL analysis improves planning by transforming contextual analysis into concrete decisions tailored to the local area, making the DRT service in Enna more realistic, accessible and sustainable from both an economic and social perspective. It therefore highlights how the integration of DRT in Enna is set within a context rich in opportunities but also characterised by certain structural challenges.

The results of the analysis are shown in Table 2.

Table 2. Identification of factors and implications for the implementation of an integrated PT-DRT transport service

Factors	Description	Implications for the DRT in Enna
Political (P)	European, national and regional policies focused on sustainable mobility and innovation	Access to public funding; need for coordination between local authorities and consistency in decision-making
Economic (E)	Local economic context and service implementation costs	Reduction in operating costs in the long term; high initial investment and need for financial sustainability
Social (S)	Demographic characteristics and mobility behaviour	Improved accessibility for outlying areas and older people; potential resistance to change and digital challenges
Technological (T)	Availability of digital technologies and service management systems	Improved service efficiency and flexibility; need for infrastructure and technological expertise
Environmental (E)	Environmental impacts and the sustainability of mobility	Reduction in emissions and private traffic; greater energy efficiency in transport
Legal (L)	Public transport legislation and regulations	Potential bureaucratic constraints; need for regulatory adjustments and integration into service contracts

The planning of an integrated DRT-PT transport service in Enna is therefore influenced by a variety of external factors: some strongly favour its implementation (such as public policy and technological innovation), whilst others require careful management (particularly regulatory, economic and social aspects).

3.3 SWOT Matrix

The SWOT analysis highlights how the integration of local public transport and on-demand transport represents a strategic solution for urban and peri-urban areas with low demand, such as the municipality of Enna [19].

However, the success of the model depends on the ability to maximise its strengths and opportunities, whilst mitigating structural weaknesses and threats related to economic sustainability and governance. The SWOT analysis is based on four categories: Strengths (positive internal factors), Weaknesses (negative internal factors), Opportunities (positive external factors) and Threats (negative external factors) [19, 31]. The SWOT analysis does not systematically cross-reference these elements: it lists, discusses and interprets them.

As regards strengths (S), Enna possesses geographical and demographic characteristics that make it particularly well-suited to a flexible transport model. The city's compact size facilitates the trailing and management of innovative services, allowing for more

direct control over operations and quicker adaptability. Furthermore, the presence of a distributed rather than concentrated demand for transport – typical of inland and hilly areas – makes on-demand transport an efficient solution compared to traditional fixed-route services, which are often underused. In this context, DRT can help optimise the use of resources, reducing empty runs and improving territorial coverage.

Alongside these positive aspects, however, several weaknesses (W) have emerged, primarily of an internal nature. Firstly, there is a limited uptake of digital skills among certain sections of the population, particularly the elderly, who may find it difficult to use the apps for booking the service. Added to this is the need to implement appropriate technological infrastructure, such as digital platforms and booking management systems, which require initial investment and specific expertise. Furthermore, the organisational complexity arising from the integration of traditional and on-demand services should not be overlooked, nor should the potential resistance to change from regular public transport users.

From the perspective of opportunities (O), the current context offers favourable conditions for the development of innovative mobility solutions. In particular, the availability of European and national funding – such as that linked to sustainability policies and the digital transition – represents a key lever for covering the start-up costs of the service. At the same time, technological advances, in terms of mobile applications and route-optimisation algorithms, make it possible to improve the efficiency and reliability of on-demand transport. Integration with public transport can also help reduce emissions and private car use, promoting more sustainable and inclusive mobility, particularly in outlying or underserved areas. Finally, it is necessary to consider certain threats arising from the external environment. These include potential regulatory and bureaucratic constraints, which could slow down the implementation of the service or limit its operational flexibility. A further risk factor is insufficient initial demand, which could compromise the economic sustainability of the system, at least during the start-up phase. Furthermore, the heavy reliance on private cars, typical of many areas like Enna, could reduce the appeal of the on-demand service. Finally, the initial implementation costs, linked both to the technology and to the reorganisation of the service, represent a critical factor that must be managed with care. Table 3 summarises the main points, describing in detail how the DRT service can bring benefits and challenges to the context analysed.

Table 3. SWOT analysis regarding the implementation of an integrated PT-DRT service in Enna

Strengths (S)	
Factor	Relevance
High flexibility and adaptability of the DRT service compared to public transport in low-density areas	Crucial for the context under analysis, and in particular for its outlying areas
Improved accessibility and equity through integrated services and reduced reliance on private cars	Consistent with the SNAI and inclusion policies

(*continued*)

Table 3. (*continued*)

Strengths (S)	
Factor	Relevance
Optimisation of the use of public resources (reduction in empty-run kilometres and replacement of inefficient services)	Important for the economic sustainability of the system
Alignment with European policies (i.e. Green Deal, development of SUMPs and MaaS)	Facilitates access to European funds
Weaknesses (W)	
Factor	Relevance
High operating costs per passenger (difficulty in economic self-sustainability)	Need for stable public funding
Management complexity (need for advanced ICT systems; coordination between operators; trained personnel.)	Need for professional development and the introduction of new roles
Digital barriers for users (exclusion of some groups such as the elderly)	Need for alternative channels (call centres)
Dependence on local governance	Improvement of administrative capacity and institutional coordination
Opportunities (O)	
Factor	Rilevance
European and national funding	Pilot schemes and scaling up
Technological innovation	Improving efficiency through the development of digital platforms, the introduction of electric vehicles and the use of AI
Combating depopulation	Improving quality of life; encouraging residents to stay; enhancing the area's appeal
Integration with social and health policies	Introduction of social and healthcare services and local welfare schemes
Threats (T)	
Uncertainty regarding funding	A lack of public funding can: jeopardise service continuity; undermine user confidence
Competition from private cars	In areas with low traffic congestion: cars remain a competitive option; demand-responsive transport (DRT) may be perceived as less convenient
Risk of fragmentation of the system	Without integrated fares and information: the system can become confusing; the user experience deteriorates

In summary, the SWOT analysis improves the planning of the DRT service in Enna because it enables a shift from a general approach to a design based on actual strengths,

specific challenges and external conditions, making the system more consistent with the needs of the local area and increasing the likelihood of successful integration with public transport. It highlights how the integration of on-demand transport into Enna's mobility system offers good potential for development but requires careful planning and targeted strategies to overcome the challenges and capitalise on the opportunities presented by the current context.

3.4 TOWS Matrix

As for the TOWS Matrix, it enables a transition from analysis (SWOT) to the formulation of strategies. The TOWS Matrix highlights how the integration of local public transport and on-demand transport can be structured through a coherent set of strategies for development, consolidation and risk mitigation. The TOWS Matrix evolved from SWOT analysis and introduced a framework for strategic cross-referencing [26]. These planning tools can help identify a range of approaches depending on who will be using them – whether administrators, technicians, service managers, or those responsible for funding the services. The TOWS analysis enables the elements identified in the SWOT analysis to be translated into operational strategies for integrating on-demand transport with local public transport in the city of Enna. In this sense, it represents a fundamental tool for guiding decision-making and defining concrete methods for implementing the service.

Firstly, SO (Strengths–Opportunities) strategies aim to capitalise on the strengths of the local context to seize the opportunities offered by the external environment. In the case of Enna, the compact size of the area and the widespread demand for mobility represent ideal conditions for launching on-demand transport pilot projects, supported by public funding allocated to sustainable mobility and innovation. Integration with advanced digital technologies can be facilitated precisely by the small scale of the urban system, allowing for more controlled and effective experimentation. Furthermore, the possibility of replacing or integrating underused traditional routes with flexible services makes it possible to improve the overall efficiency of the system. WO (Weaknesses–Opportunities) strategies, on the other hand, focus on reducing internal weaknesses by capitalising on external opportunities. In this context, the challenges associated with limited digital literacy can be addressed through training and awareness-raising programmes aimed at the public, potentially funded by public money. At the same time, the available financial resources can be used to develop appropriate technological infrastructure, thereby reducing the burden of initial investment. A particularly important factor is the introduction of alternative methods of accessing the service to digital apps, such as telephone booking, which allows for a wider user base and makes the service more inclusive. As regards ST (Strengths–Threats) strategies, these aim to use the system's strengths to counter external threats. The inherent flexibility of on-demand transport, for example, makes it possible to adapt supply to actual demand, thereby reducing the risk of economic inefficiency when demand levels are uncertain. Furthermore, greater operational efficiency can help to contain costs and make the service more competitive compared to the use of private cars. In a context characterised by potential regulatory or bureaucratic constraints, small-scale trials can represent an effective strategy for demonstrating the validity of the model and promoting its gradual institutionalisation. Finally,

WT (Weaknesses–Threats) strategies take on a defensive character and aim to minimise both internal weaknesses and external threats. From this perspective, it is advisable to plan for a gradual introduction of the service, through successive phases of trialling and expansion, to limit risks and address any critical issues as the project progress. Continuous monitoring of demand and service performance is essential to ensure a balance between costs and benefits. Furthermore, fare and operational integration with existing public transport can encourage user acceptance and improve overall accessibility. Finally, collaboration between local authorities, operators and institutions is key to overcoming regulatory obstacles and ensuring the coordinated and effective management of the system. Overall, the TOWS analysis highlights that the integration of on-demand transport in Enna should not be viewed merely as a technological innovation, but as a complex strategic process requiring a careful combination of resources, expertise and public policies to be successfully implemented. In particular, the use of European funds and policies for inland areas makes it possible to overcome the main weaknesses of DRT, whilst the flexibility of the service is a key factor in countering threats related to economic sustainability and social acceptability. In other words, by considering the S–O aspects, it is possible to highlight the strengths to seize the opportunities, as shown in Table 4.

Table 4. Analysis of S-O Strategies, i.e. Development and Growth Strategies

S–O Strategies (Strengths + Opportunities)		
Strengths (S)	Opportunities (O)	S–O Strategies
Flexibility of the DRT	EU funds / PNRR	Develop funded pilot DRT services
Equity and inclusion	SNAI policies	Position DRT as an essential service
Alignment with the SUMP	Technological innovation	Integrate DRT into MaaS frameworks
Operational efficiency	Local welfare	DRT as a social and healthcare service

About the case study, the potential of the Canalicchio and Enna Alta areas as SNAI pilot zones is highlighted, along with the possible implementation of strategies to access PNRR funds for digitalisation and electric vehicles. This translates into the planning of strategies for the expansion of the integrated service and innovation. By considering the W–O framework to overcome weaknesses by exploiting opportunities, the results shown in Table 5 below are obtained.

Table 5. W-O Strategy Analysis, i.e. Strategies for Improvement and Consolidation

W–O Strategies (Weaknesses + Opportunities)		
Weaknesses (W)	Opportunities (O)	Opportunities (O)
High costs	EU funding	EU funding
Management complexity	ICT innovation	ICT innovation
Digital barriers	Social inclusion	Social inclusion

(*continued*)

Table 5. (*continued*)

W–O Strategies (Weaknesses + Opportunities)		
Weaknesses (W)	Opportunities (O)	Opportunities (O)
Weak governance	Interreg programmes	Interreg programmes

These considerations could, for example, encourage the implementation of strategies for using ERDF funds for DRT platforms and the creation of dedicated call centres for elderly users. This therefore highlights the need for measures aimed at structural strengthening. Regarding the S–T combination, however, it is worth noting the value of leveraging strengths to mitigate threats, as shown in Table 6.

Table 6. Analysis of S-T Strategies or Active Defense Strategies

S–T Strategies (Strengths + Threats)		
Strengths (S)	Threats (T)	S–T Strategies
Flexibility	Competition from cars	Improving reliability and journey times
Integration of public transport and on-demand transport	Fragmentation	Integrated ticketing
Accessibility	Low uptake	Targeted information campaigns
Efficiency	Funding instability	Demonstrating results (e.g. calculating indices such as CSI composite indices)

Finally, about the W–T combination, the aim is to minimise the impact of weaknesses and threats (defensive strategies). The analysis of the W–T combination is shown in Table 7.

Table 7. Analysis of Mitigation and Control Strategies

W–T Strategies (Weaknesses + Threats)		
Weaknesses (W)	Threats (T)	W–T Strategies
High costs	Ground instability	Gradual roll-out of the service
Complexity	Fragmentation	Single public authority
Digital divide	Low participation	User support
Weak governance	Discontinuity	Multi-year service agreements

In summary, SO (Strengths–Opportunities) strategies make it possible to capitalise on the region's strengths (its compact size and dispersed demand) to seize available opportunities, such as launching a publicly funded pilot project focused on outlying

areas. One resulting measure, for example, is to replace a low-passenger-volume route with a DRT service, testing its effectiveness at a low cost. WO (Weaknesses–Opportunities) strategies enable weaknesses to be overcome by exploiting external opportunities; for instance, the limited digital literacy of the elderly population can be addressed by using funding to develop an inclusive access system. For example, one could envisage the creation of a multi-channel booking service (app + telephone) accompanied by user training campaigns, thereby improving the service's accessibility. ST (Strengths–Threats) strategies enable the use of strengths to counter threats; this means, for example, being able to implement a system that operates journeys by booking only, reducing waste and making the service more economically sustainable. Finally, WT (Weaknesses–Threats) strategies are defensive in nature and aim to reduce risks and critical issues; they may propose, as a concrete solution, the launch of a pilot phase limited in time and scope, with continuous performance monitoring and the possibility of adaptation prior to large-scale implementation. In summary, the TOWS analysis improves DRT planning in Enna because it enables a transition from analysis to strategy, translating the information gathered into concrete, targeted and realistic actions, thereby increasing the effectiveness and sustainability of integration with public transport.

4 Discussion

The implementation of flexible services presents an opportunity for the environmental, economic and social sustainability of transport systems. Their characteristics – flexibility, variable routes, door-to-door service and reduced capacity – make them particularly well-suited to contexts with low demand, where traditional scheduled services may prove inefficient. On-demand services, however, present significant implementation challenges. Key implementation challenges include fare coordination (single ticket), multi-stakeholder governance (different operators for the two sectors) and data sharing; these are complex issues that require time and investment. Furthermore, financial sustainability remains a central issue, particularly in the initial roll-out phases of integrated services.

This article discusses the possibility of integrating on-demand transport with local public transport in the city of Enna. SWOT, TOWS and PESTEL analyses were conducted; the three analyses differ in terms of their role and level of detail, whilst being complementary to one another. Given the various stakeholders involved in implementing a DRT service integrated with public transport in Enna, the PESTEL, SWOT and TOWS analyses offer specific benefits for each role. For public authorities, the PESTEL analysis is essential for understanding the regulatory, political and social framework within which they operate, whilst the SWOT analysis enables them to assess the local context, and the TOWS analysis supports the formulation of mobility policies and strategies. For transport operators, the SWOT analysis is particularly useful for analysing their operational capabilities and critical issues, whilst the TOWS analysis helps to translate these assessments into concrete management decisions; PESTEL, on the other hand, provides insights into external constraints and market opportunities. Planners use PESTEL to analyse the territorial and socio-economic context, SWOT to structure a concise overview of the system's conditions, and TOWS to develop scenarios and project strategies.

Finally, those involved in financing find PESTEL a useful tool for assessing macroeconomic and regulatory risks and opportunities, SWOT a means of understanding the project's soundness, and TOWS a reference for verifying the consistency and feasibility of the proposed strategies. With regard to the specific application to PT–DRT systems, it should be noted that PESTEL analysis enables the identification of constraints and risks (for example, those related to legislation, implementation costs or the social characteristics of the population) and supports strategic planning, making it possible to design a service that is consistent with the local context and easier to implement. The SWOT analysis highlights why traditional PT does not work on its own but demonstrates the potential of DRT and identifies territorial constraints (gradient, dispersion). As regards the TOWS analysis, it is worth noting that it indicates where to introduce DRT and how to integrate it with PT; it supports roadmaps and quantitative targets and is a tool consistent with SUMP and EU calls for proposals. Therefore, the SWOT analysis represents an indispensable phase of strategic diagnosis, but it is through the TOWS Matrix that the elements identified are translated into operational and territorialised strategies, making the approach particularly suitable for the planning of integrated PT–DRT public transport systems.

5 Conclusion

The results obtained through the sequential application of the three methodologies highlight the potential of the approach developed as a decision-support tool for a wide range of stakeholders involved in the planning and management of transport systems. There are various stakeholders who stand to benefit from this work.

Firstly, transport service operators, for whom the proposed framework enables the identification of operational guidelines useful for defining the characteristics of the service offering, thereby promoting a better match between demand and service capacity; in this way, it contributes to improving economic and operational efficiency.

The analysis enables the identification of spatial and temporal criticalities in the distribution of mobility demand, allowing for more effective targeting of any service redesign interventions. Secondly, public administrations and local authorities. For them, the research findings provide a structured analytical basis to support decision-making processes in the fields of mobility policy and spatial planning.

The proposed approach can contribute to the definition of integrated transport and accessibility strategies, as well as to a more efficient allocation of public resources, facilitating targeted interventions in areas characterised by greater challenges in terms of access to essential services.

As this is an initial stage of the investigation, the authors emphasise that future research in this field will need to establish a more robust methodological framework for the integrated application of PESTEL, SWOT and TOWS analyses in the case study concerning the integration of public transport (PT) and demand-responsive transport (DRT) in the city of Enna.

Future research steps will aim to define a structured, reproducible and valid protocol, avoiding a simple sequential use of the three models (such as steps involving the collection of territorial and transport data, classification and selection processes for

the identification of enabling and critical factors; identification of structural constraints and strategic opportunities). Finally, a quantitative analysis will be carried out using a multi-criteria weighting system (such as AHP or a weighted evaluation matrix) and the definition of specific quantitative indicators of accessibility and performance, useful both for ex-ante evaluation and for monitoring the service.

Finally, the article is of interest to the public, for whom a planning system supported by analytical tools of this kind can translate into tangible benefits in terms of improved access to services, a reduction in regional inequalities, and an overall improvement in the quality of the public transport system.

Focusing on the mobility needs of potentially vulnerable groups helps to promote a more equitable and inclusive transport system. Overall, this research contributes to the preliminary analysis and development of more inclusive, resilient and sustainable mobility models, with reference to peri-urban contexts in inland areas, where the combination of dispersed demand, limited availability of services and socio-demographic fragility makes the adoption of innovative approaches to mobility planning particularly relevant.

From this perspective, the proposed framework represents a step towards integrating accessibility analysis, service optimisation and territorial development policies, whilst opening the way for future research developments aimed at expanding the scope of application and integrating further dimensions of sustainable mobility.

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