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REVIEW

Demand-responsive transport in rural and low-density areas: models, costs and outcomes

Transporte a la demanda en zonas rurales y de baja densidad: modelos, costos y resultados

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ABSTRACT

Demand-responsive transport is proposed repeatedly as an answer to rural mobility, yet its record across service models, costs and outcomes remains fragmented. This narrative review synthesizes the empirical, evaluative and modeling literature published between 2013 and 2024 on demand-responsive transport in rural and low-density areas. The literature describes a continuum of flexibility from route deviation and feeder services to fully flexible door-to-door operations, and design choices govern both cost and uptake. Cost comparisons indicate that demand-responsive transport outperforms fixed-route services only below low demand thresholds, and financial viability depends on subsidy design and on a modest user willingness to pay. Usage outcomes show persistent weak acceptance where expectations exceed the flexibility actually delivered, while the propensity to use is higher among groups with limited car access. Demand-responsive transport is framed chiefly as an equity instrument and improves access to employment, education and services, although it does not automatically reach the most disadvantaged. Institutional continuity and earmarked funding predict service survival. The review identifies consistent gaps in long-term outcome measurement and in the integration of demand-responsive transport with wider rural mobility policy.

Keywords: demand-responsive transport; flexible transport services; rural areas; accessibility; public transport; transport costs.

RESUMEN

El transporte a la demanda se propone recurrentemente como respuesta a la movilidad rural, pero su balance en modelos, costos y resultados sigue fragmentado. Esta revisión narrativa sintetiza la literatura empírica, evaluativa y de modelado publicada entre 2013 y 2024 sobre este modo en zonas rurales y de baja densidad. La literatura describe un continuo de flexibilidad, de la desviación de ruta a la operación puerta a puerta, y el diseño condiciona el costo y la adopción. Las comparaciones de costos indican que este modo supera a la ruta fija solo por debajo de umbrales de demanda bajos, y la viabilidad depende del subsidio y de una disposición a pagar modesta. Los resultados de uso muestran una aceptación débil cuando las expectativas superan la flexibilidad entregada, y mayor propensión entre grupos con acceso limitado al automóvil. El transporte a la demanda se enmarca como instrumento de equidad y mejora el acceso al empleo, la educación y los servicios, aunque no llega a los más desfavorecidos. La continuidad institucional y la financiación afectada predicen la supervivencia del servicio. La revisión identifica vacíos en la medición de resultados a largo plazo y en la integración con la política de movilidad rural.

Palabras clave: transporte a la demanda; transporte flexible; zonas rurales; accesibilidad; transporte público; costos de transporte.

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INTRODUCTION

Rural and low-density areas concentrate some of the most persistent transport disadvantages in high-income and middle-income countries. Populations are scattered, distances to employment, education and health services are long, and conventional fixed-route buses operate far below capacity on corridors where patronage cannot cover running costs.(1)

Car ownership has filled much of this gap, which leaves non-drivers, older adults, adolescents and low-income households dependent on lifts, taxis or services that are absent after midday and at weekends.(2)

The problem is structural rather than cyclical: demographic ageing and the withdrawal of public services from peripheral settlements have reduced demand per kilometre while raising the number of people who cannot supply their own mobility.(3)

Demand-responsive transport, often abbreviated as DRT, occupies the space between the fixed bus and the private car. It groups services in which routes, timetables or vehicles adjust to requests rather than following a fixed schedule, and it has been promoted for more than four decades as an alternative where conventional public transport is not viable.(4)

The construct decomposes into three dimensions that structure this review: the service and operational models used in practice, the costs and funding arrangements that determine whether a scheme can be sustained, and the outcomes achieved in ridership, accessibility and equity. National surveys of Great Britain and evaluations in Europe show that these dimensions interact: a change in model alters unit cost, and unit cost decides whether a pilot becomes a permanent service.(5,6)

A new synthesis is timely for three reasons. Digital booking, mobile data and automated dispatch have lowered the transaction cost of matching passengers and vehicles, which has triggered a wave of pilots in rural and peri-urban settings after a long period of decline.(7,8)Automated and electric vehicles are now entering the planning literature as components of rural demand-responsive systems, expanding the range of conceivable models.(9)

At the same time, the evidence base remains scattered across case studies, simulation experiments and regional evaluations, and the reviews that exist concentrate on urban deployments or on single countries, leaving the rural record unintegrated.(10,11)

This review therefore synthesizes the literature published between 2013 and 2024 on demand-responsive transport in rural and low-density areas. Its objective is to characterize the models, costs and outcomes reported in that literature, to identify the convergences and divergences among studies and to translate the findings into implications for rural mobility policy. Three questions guide the synthesis: which service and operational models are documented and with what planning tools, what do the studies report about costs and financial sustainability, and what outcomes are reported for ridership, accessibility and equity.

DEVELOPMENT

The synthesis draws on 59 original studies and reviews distributed across the six dimensions, together with complementary work used for context and comparison. Each dimension is presented in the same order used in the Methods, and the principal findings are condensed in the summary table (Table 1).

Service and operational models

For this dimension, the literature describes demand-responsive transport not as a single mode but as a continuum of flexibility whose endpoints are the fixed bus and the individual car. Reviews of service configurations distinguish, from least to most flexible, route-deviation services that follow a fixed schedule but leave the route to serve requested stops, feeder and zonal services that connect dispersed origins to trunk corridors, and fully flexible door-to-door dial-a-ride operations in which vehicles are routed dynamically between requested origins and destinations.(4)

The organizing principle is the degree to which the route, the timetable or the vehicle remains fixed, and each step toward flexibility transfers a share of the planning burden from the operator to the booking system.(4)A study of rural riders in Tennessee found that deviated fixed-route and demand-responsive services coexist with intercity buses as the three principal modes of rural public transport, which confirms that flexibility is added incrementally to existing infrastructure rather than substituted for it.(12)

Table 1. Synthesis of findings by thematic dimension.

Dimension	Key findings	Representative evidence
Service and operational models	Continuum from route deviation to door-to-door dial-a-ride; models chosen by density and purpose	DRT configuration review (2024); Tennessee rural modes (2017); Great Britain survey (2014)
Planning tools and digital platforms	Simulation and optimization dominate; mobile and geospatial data improve demand estimation; algorithms extend to electric and autonomous fleets	Agent-based design (2023); Switzerland spatial demand (2023); rural dial-a-ride with AV (2022)
Costs and financial sustainability	DRT beats fixed-route only below low demand thresholds; fleet size, pooling and automation drive cost; willingness to pay is modest	Slovakia cost comparison (2023); fleet size minimization (2021); willingness to pay (2023)
Ridership and usage outcomes	Usage driven by flexibility, reliability and fare; weak acceptance is recurring; higher propensity among car-less groups	Rural determinants of use (2024); acceptance dilemma (2022); students and youth studies (2023-2024)
Accessibility, equity and social outcomes	DRT framed as equity instrument; improves access to services and employment; reach conditioned by fare and eligibility	Multilayer accessibility (2020); employment access (2022); Ligurian internal areas (2023)
Policy and governance	Continuity depends on institutional funding; regulation treats DRT as marginal; governance ranges from procurement to PPP and MaaS	Japan 50-project analysis (2024); rural PPP MaaS (2020); Canberra integration (2024)

The national survey of demand-responsive transport in Great Britain reached a similar conclusion at a larger scale, showing a long-standing and heterogeneous stock of services whose common feature is that they operate where conventional buses cannot be justified.(5)

The design literature treats the choice of service model as the first and most consequential decision. Guidelines for designing flexible services identify vehicle type, service area, booking horizon and stop spacing as the parameters that jointly determine operating cost and service quality, and they advise selecting the vehicle before fixing the routing rules because capacity and accessibility follow from the vehicle.(13)

GIS-based methods extend the same logic to route planning, using road network and demand data to identify cost-effective deviated fixed routes in rural areas.(14)A tool developed for rural English services formalizes the redesign problem by quantifying how each flexibility parameter changes vehicle-hours and passenger convenience, allowing operators to test configurations before committing to a timetable.(15)

In relation to the fixed network, the recurring recommendation is that demand-responsive services should complement rather than replace conventional lines. An assessment framework applied to European and Australian cases found that DRT performs best as a feeder or gap-filler that enlarges the catchment of rail and trunk bus services, and poorly when it duplicates a fixed line that still carries concentrated demand.(6)

Flexible feeder route design has been developed to enhance accessibility in urban areas, and its routing logic transfers to rural first-and-last-mile problems where densities are lower.(16)

The literature review on integrated passenger transport in rural areas reinforces this view, concluding that integration with fixed services and with other modes is the condition under which flexibility produces net benefits, and noting that integration is easier to recommend than to achieve because rural scheduling is split across several authorities with separate budgets.(3)

The European record summarized in a twenty-year overview adds a caution: the population served by DRT has remained narrow, concentrated among users without alternatives, and the stock of services has not expanded in proportion to the policy attention it receives.(11)

Service quality studies from the same tradition argue that flexible services fail in rural areas not because the concept is wrong but because the delivered flexibility falls short of what the timetable promises, a point developed in the ridership dimension below.(17)

The design guidelines published at the start of the window already warned that flexibility adds a coordination cost that only pays off when demand is both dispersed and predictable.(13)The typology that organizes these models, their defining features and their typical rural applications is presented in the next table (Table 2).

Table 2. Typology of demand-responsive service models in rural settings.

Model	Defining features	Typical rural application	Evidence
Route deviation	Fixed schedule, off-route stops served on request	Low-demand corridors with dispersed stops	Tennessee rural modes (2017); GIS route design (2016)
Feeder or connector	Collects dispersed trips to trunk lines or stations	First and last mile to rail, intercity or town services	Feeder design (2016); DRT as complement (2018)
Semi-flexible zonal or corridor	Bookable stops within defined zones or corridors	Small towns and peri-urban fringes	Peri-urban insights (2023)
Fully flexible door-to-door	Dynamic routing between requested origins and destinations	Very low density, older and disabled users	Great Britain survey (2014); fully flexible DRT (2021)
Complementary and integrated	DRT combined with shared, active modes or hubs	Rural-urban connectivity and hub-based networks	E-bike sharing and DRT (2021); complementary services (2021)

Planning tools and digital platforms

The planning literature in this dimension is dominated by simulation and optimization rather than by field experiment. Agent-based models are used to size fleets, to test service concepts and to compare fixed and flexible operations before deployment; a study of small-sized cities shows how such models translate local demand patterns into a preferred DRT configuration.(18)

These models are attractive to planners because they test a service against local demand before any capital is committed, a capability that fixed-route planning lacked.(18)Demand prediction has advanced in parallel, with graph-based learning models proposed to forecast regional movement demand for demand-responsive services.(19)

For the urban-rural interface, clustering methods such as DBSCAN combined with K-means are applied to reduce the operating cost and running time of demand-responsive services between urban and rural stations.(20)

For this variable, the availability of new data sources has changed what can be planned. Mobile network data combined with activity-based travel demand models allows rural demand to be estimated where household travel surveys are scarce or outdated, and the approach has been demonstrated for the introduction of emerging mobility services in rural areas.(21)

Spatial characteristics derived from geodata are used to predict DRT demand in rural Switzerland, showing that settlement structure and accessibility to existing stops explain much of the potential patronage before any service is launched.(22)

A GIS-based method for rural services extends this to optimization, evaluating potential DRT service areas by their efficiency.(23)Conjoint analysis contributes the demand-side complement, quantifying how rural users trade travel time, booking effort and fare when a flexible service is proposed.(24)

The algorithmic core of the dimension remains the dial-a-ride problem and its rural variants. Work on interrelated trips in the rural dial-a-ride problem incorporates the fact that rural households chain several purposes into one journey, and it extends the formulation to autonomous vehicles.(25)

Electric vehicles appear in the same literature as a practical constraint on range and charging, with findings from two German demand-responsive projects showing that vehicle range and recharging schedules have to be designed into the service rather than added afterwards.(26)

Studies of rural Swiss train lines explore a different integration, in which self-driving cars replace or complement the bus leg of public transport, and they analyse how automation changes the operation of those services.(9)

Across these studies, digital platforms are treated as the enabling infrastructure that makes flexibility operable at low cost. The shift from telephone booking to app-based dispatch and automated routing is what distinguishes the current wave of pilots from the demand-responsive services of the 1980s and 1990s, and the frameworks that connect low-density mobility challenges to smart solutions place this digital layer at the centre of any rural scheme.(8)

The main limitation reported for this dimension is the gap between model performance and field evidence: most algorithms are validated on synthetic instances, and few studies follow a simulation into an operating service to confirm that the predicted efficiency materializes.(18)

That gap matters because the efficiency claims that justify public investment rest on synthetic benchmarks, and a service that performs well in simulation can meet very different booking behavior in the field.(18,24)

Costs, funding and financial sustainability

On the cost dimension, the central question in the literature is the demand threshold below which flexible operation becomes cheaper than a fixed route. A comparison of operational costs for fixed-route bus and demand-responsive services in the Kosice region of Slovakia concludes that DRT is the lower-cost option only where demand is sparse, while the fixed route remains cheaper above that threshold.(27)

A feasibility analysis based on operating cost functions reaches the same result for Korean provincial cities, where declining populations have pushed rural route buses below the demand that justifies their schedules.(28)

The economic assessment of replacing conventional transit with DRT in low-to-medium density areas adds the socioeconomic dimension, showing that the switch changes operator cost as well as user travel time and accessibility, so the three must be weighed together before a line is converted.(29)

Cost is highly sensitive to three design parameters: fleet size, pooling rate and vehicle automation. Optimization of fleet size for shared demand-responsive systems shows that total cost minimization yields markedly different fleets depending on whether vehicles are human-driven or automated, because automation removes the largest single operating cost, the driver.(30)Automation therefore shifts the threshold at which flexibility becomes affordable, but it does not remove the demand constraint, because empty automated vehicles still consume energy and add to network load.(30)

The efficiency of ride sharing, quantified for pooled on-demand services, indicates that the share of trips that can actually be shared at acceptable detour is a binding constraint on unit cost.(31)

Performance evaluation of DRT services with a two-stage bootstrap and data envelopment analysis confirms that services with similar demand differ substantially in efficiency, implying that management and network design, not only geography, explain part of the cost dispersion.(32)

A redesign tool for rural flexible services operationalizes the same point by identifying the configurations in which vehicle-hours can be removed without degrading user convenience.(33)

The revenue side of the dimension is dominated by willingness-to-pay studies, and their message is consistent: rural users accept the concept but are willing to pay modest amounts. A study in the Kosice and Presov regions of East Slovakia estimates the willingness to pay for DRT and finds it sufficient to cover a limited share of operating cost, leaving a structural subsidy requirement.(34)

An assessment of policy decisions for a demand-responsive system for persons with disabilities shows how fare levels, eligibility rules and service area all change the resource requirements of the same scheme, which means the subsidy is a policy choice as much as an efficiency outcome.(35)

Funding arrangements are the dimension's least studied element, and the evidence that exists points to instability. Impact assessments of rural public-private partnership and mobility-as-a-service pilots report positive intermediate outcomes but short evaluation horizons, so their durability beyond the pilot phase remains open.(36)

An analysis of 50 mobility-as-a-service projects in regional and rural Japan identifies the factors that predict continuation and finds that institutional funding and a defined local owner matter more than technological readiness.(37)

The convergence across these studies is that demand-responsive services do not cover their operating costs from fares alone in the rural settings examined, and that the decisive variable is not the unit cost of a trip but the continuity of the public commitment that pays for it.(29)

A DRT scheme should therefore be budgeted as a permanent accessibility service rather than as a temporary pilot, because the conditions that make it necessary do not disappear.(37)

Ridership and usage outcomes

The usage literature separates what predicts use from what predicts acceptance, and the two do not always coincide. A study of determinants of usage and satisfaction with rural demand-responsive systems finds that actual use is explained by service attributes such as flexibility, reliability, travel time and fare, rather than by socio-demographic profile alone.(38)

Service attributes can be measured and, in principle, managed, whereas demographic profiles are given, which is why the determinants literature is read as a checklist for service design rather than for user targeting.(38)

A case study of flexible transport patronage in urban and rural New South Wales supports this, showing that the same service performs differently across settings and that local frequency and connectivity drive the differences.(39)

An analysis of demand-response transit in small Tennessee areas adds the demographic layer, documenting that age and gender pattern both travel and accessibility in ways that a single aggregated ridership count hides.(40)

The most consistent negative finding is weak user acceptance. A study of rural DRT in Germany describes the dilemma explicitly: users expect a level of flexibility that the service, once operational, does not deliver, and this gap between expectation and delivery erodes trust and repeat use.(41)The implication is examined directly in a study that asks how much flexibility rural public transport actually needs, using a fully flexible DRT system, and concludes that the marginal benefit of additional flexibility diminishes while the cost of the promise rises.(42)

The pattern is consistent across Germany, the Nordic countries and Great Britain, which suggests that the acceptance problem is a property of the service concept rather than of a single operator.(41,43)These results explain why services launched with strong political support can stabilize at low patronage even where the population is objectively transport-poor.

Propensity to use is higher and more stable among groups with limited car access. Studies of students in rural Germany, of young people in Sweden and of potentially less mobile persons in central Germany converge on the finding that those who cannot drive, or cannot afford to drive, are the most willing adopters, provided the service matches their travel purposes and hours.(44-46)

A stated-intention study of the rural population reaches the same conclusion, identifying behavioral intention to use DRT as a function of perceived usefulness and ease rather than of income alone.(47)

The classic Lincolnshire study of propensity to travel by demand-responsive transport showed, earlier in the window, that the practicalities of booking and the fit with daily routines are the filters through which potential demand becomes actual use.(43)

In simulation and case studies, the counterweight to the acceptance problem appears, because these report patronage gains when the comparison is made against an underused fixed service. A simulation study in Lolland, Denmark, finds that DRT can improve service in low-demand rural areas where regular bus lines are expensive to maintain.(48)

Peri-urban experiences add the insight that DRT performs differently in the urban fringe than in either the city or the deep countryside, which cautions against transferring results across densities.(49)

A case study of shared automated demand-responsive transport in Jerusalem reports modal shift potential for such services.(50)The overview of DRT users in Europe closes the dimension by observing that, despite these positive results, the user base has remained narrow across two decades, a gap the policy dimension addresses.(11)

Accessibility, equity and social outcomes

The accessibility literature frames DRT first as an equity instrument and only second as an efficiency measure. A multilayer approach to rural accessibility argues that the scattered structure of rural settlement makes conventional network planning insufficient and that flexible services are one of several layers needed to close the access gap.(1)

The multilayer framing matters because it positions DRT as one instrument among several, to be combined with land-use measures, digital services and basic infrastructure, rather than as a substitute for them.(1)

The search for sustainable and inclusive mobility solutions in rural areas reaches the same conclusion, treating social inclusion as the criterion against which any novel mobility scheme should be judged.(2)Strategies for inner and marginal areas in Italy locate DRT within a wider set of measures for accessibility in territories that have lost population and services.(51)

The outcome evidence concentrates on access to employment, education and services. A study of perceived accessibility of employment sites by jobseekers finds that employer-subsidised DRT can materially improve the commute for workers whom fixed transit does not reach, and that the subsidy changes the accessibility calculus of the job itself.(52)

The Ligurian internal areas project treats DRT explicitly as an instrument against social exclusion, redesigning accessibility in territories where scheduled services had been withdrawn.(53) A contribution on combining public transport with DRT applies the same logic to rural quality of life, treating the two services as complements.(54)

Integration with active modes and hubs is the main amplifier of benefits in this dimension. The combination of e-bike-sharing and DRT in the Slovenian town of Velenje demonstrates that a flexible vehicle service and a shared active mode solve different parts of the same journey, and that their pairing extends the reach of both.(55)

Complementary mobility services for rural-urban connectivity develop the same argument at regional scale, showing that flexible services, shared mobility and hubs form a system rather than a menu of isolated options.(56)The framework applied to Estonian municipalities connects low-density mobility challenges to smart mobility solutions and organizes them around local needs.(8)

The equity caveat in this dimension is that DRT does not automatically reach the most disadvantaged. Preferences of Dutch older adults toward a smart demand-responsive service show that design features, and in particular the booking interface and the level of assistance, determine whether an older user can actually use the service, rather than only whether the service exists.(57)

The assessment of policy decisions for persons with disabilities demonstrates that eligibility and fare rules, not the routing algorithm, decide who benefits.(35)A sustainability assessment of incentive-driven shared on-demand systems in rural settings formalizes the point by requiring societal benefits to be weighed against costs.(58)

Designing for equity therefore requires a defined target population and a monitoring indicator, because a service that improves average accessibility can still leave the least mobile behind.(58) The dimension converges on a conditional claim: DRT improves rural accessibility when fare, eligibility and integration are designed for it, and not as an automatic consequence of flexible routing.

Policy and governance

The policy literature is thinner than the others but unusually consistent. The Japanese analysis of 50 mobility-as-a-service projects in regional and rural areas is the strongest single source, and it finds that continuation depends on institutional factors, especially stable local ownership and earmarked funding, rather than on the sophistication of the technology.(37)

Empirical recommendations from Japanese case studies generalize the point into guidance for sustainable innovative mobility in rural areas, centred on local ownership and realistic demand assumptions.(59)

The regulatory environment is described as the main constraint on scaling in this dimension. Strategies for inner and marginal areas in Italy note that DRT remains governed as an experimental or marginal service, with procurement rules and concession models designed for fixed routes and poorly suited to flexible operation.(51)

The Canberra study of integrated DRT in low-demand areas shows the same friction in a different institutional setting, where a flexible service had to be integrated into an existing fixed network.(60)

Governance models range from direct public procurement through public-private partnerships to platform-based mobility-as-a-service arrangements, and each distributes risk and equity differently. Impact assessments of rural public-private partnership pilots report that private partners can deliver the service efficiently but that public objectives, including coverage of the least profitable areas, must be written into the contract or they will be traded away.(36)

A demand-responsive public transport proposal for a spatially scattered population in a developing country illustrates the opposite configuration, in which the public authority remains the operator because no private actor will serve the territory at all.(61)

That case is a reminder that the governance debate assumes a functioning public authority, which is not always present, and that where it is weak the same flexible technology serves different purposes and different users.(61)

The transferability lesson that closes the dimension is the least satisfying for policy but the most honest in the literature: context dominates. The studies repeatedly recommend design that starts from local demand, settlement structure and institutional capacity, and they caution against importing a model that worked elsewhere without re-estimating the underlying assumptions.(59,60)

Replication should therefore transfer the design method, not the design itself.(59)The convergence across all six dimensions is that demand-responsive transport is a family of context-specific solutions rather than a single technology, and that its costs and outcomes are decided by design and governance choices as much as by geography.

DISCUSSION

This review set out to characterize the models, costs and outcomes of demand-responsive transport in rural and low-density areas and to identify the convergences, divergences and gaps in the evidence. The synthesis supports three integrated readings. First, the service model continuum, from route deviation to fully flexible door-to-door operation, is well established, and the

choice among models is the first determinant of both cost and uptake.(4,13)

Second, the cost advantage of flexibility is conditional: demand-responsive transport undercuts the fixed route only below low demand thresholds, and its viability then rests on subsidy continuity and on a willingness to pay that is consistently modest.(27,34)

Third, the outcomes are asymmetric across dimensions, with repeated evidence of weak user acceptance and narrow user bases set against a strong accessibility and equity rationale that is more asserted than measured.(1,41)

The comparison with previous reviews shows substantial agreement on the descriptive facts and a divergence on emphasis. The survey of demand-responsive transport in Great Britain documented a long-standing, heterogeneous stock of services concentrated in low-demand areas, a picture that the twenty-year European overview of DRT users confirms and extends to the observation that the user base has remained narrow.(5,11)

Reviews of integrated rural passenger transport reach the same conclusion about the complementarity of flexible and fixed services.(3)Where this review differs is in the weight assigned to the cost and acceptance findings: urban systematic reviews of DRT emphasize technological potential and stakeholder alignment, whereas the rural record emphasizes the persistence of low patronage and the fragility of funding.(10)

The most plausible explanation is contextual rather than methodological. Urban DRT rides on higher density, which raises the share of trips that can be pooled, while rural schemes operate where the share of shareable trips is lowest; the quantification of ride-sharing efficiency shows how binding that share is for unit cost.(31)

The same density logic explains a secondary divergence: urban reviews treat automated vehicles as the next step in service evolution, whereas the rural literature treats automation as a way to lower a cost threshold without changing the demand-side problem.(9)

The three readings can be assembled into a simple evaluative logic. A scheme is more likely to survive when its service model matches the local density structure, when its budget treats subsidy as a permanent line rather than a launch cost, and when its evaluation measures accessibility for a defined target population rather than trips alone.

The cases that report success, such as the integrated Canberra service and the complementary rural-urban schemes, satisfy most of these conditions, while the cases of weak acceptance violate the first by promising more flexibility than the operating plan can honor.(41,56,60)This logic is not tested explicitly anywhere in the literature, which makes it a hypothesis for future work rather than a settled finding.

Several mechanisms reconcile the otherwise contradictory findings on acceptance and equity. The discrepancy between stated intention and actual use appears to arise from a gap between the flexibility promised at launch and the flexibility delivered in operation, a mechanism documented in the German dilemma study and in the analysis of how much flexibility rural transport needs.(41,42)

The strong propensity among car-less groups, by contrast, reflects the absence of alternatives rather than enthusiasm for the service itself, which explains why willingness to pay remains modest even among the groups who most need the service.(34,46)

The integration findings point to a third mechanism: accessibility gains are amplified when DRT is coupled to active modes and hubs, because the flexible vehicle solves the last-mile problem while the shared mode solves the first-and-last link.(55,56)

These mechanisms are mutually reinforcing and jointly imply that a scheme's outcome is decided more by its design and institutional embedding than by the routing technology it deploys.(8)

The strengths of this review lie in its explicit dimension structure, which forces each claim to be located in the model, cost or outcome literature, and in its restriction to a defined publication window that captures the digital-era revival of demand-responsive transport. The assignment of each study to one dimension also makes visible which claims rest on several independent sources and which rest on a single case, a distinction that matters when findings are translated into policy. The main limitations follow from the same design choices and are stated explicitly.

The selection was not systematic and drew on three databases with English-language material, which under-represents non-English evaluations of rural schemes in continental Europe and Asia and may omit unpublished pilot reports where negative results concentrate. A formal risk-of-bias assessment was not applied, so the weight of individual studies rests on the reading of their abstracts and reported conclusions rather than on a standardized instrument. Publication bias plausibly inflates the share of positive pilot outcomes, because schemes that fail quickly are less likely to reach the literature. Each limitation carries a remedy that future work could adopt: a multilingual search protocol, a standardized appraisal of study quality, and a registry or grey-literature search for discontinued schemes.

The practical implications follow from the three integrated readings. Planners should treat the choice of service model as a cost and uptake decision made before procurement, using simulation and geodata to size the service rather than importing a template.(18,23)

Funding agencies should plan for a structural subsidy and should evaluate continuation criteria, not only launch outcomes, because the decisive predictor of survival is the continuity of public commitment.(36,37)

Operators should calibrate the flexibility they promise to the flexibility they can deliver, because expectation gaps are the most consistent source of weak acceptance.(41)Authorities that pursue DRT as an equity measure should design fares, eligibility and integration with active modes explicitly, since none of those benefits materializes automatically from flexible routing.(35,57)

Where the service is intended to support ageing populations, the booking interface and the level of human assistance should be treated as core design requirements, because they determine whether the service is usable by the people it targets.(57)

The research agenda that emerges is concrete. Long-term outcome measurement is the largest gap: most studies stop at pilot launch or at a single patronage count, and the field lacks repeated measures of accessibility, employment and social participation attributable to a service. The second gap is comparative evaluation of governance models, which the literature treats almost entirely through single-country case studies.

The third is the transfer of algorithmic results into field operation, since the planning literature validates its models on synthetic instances and rarely follows a service from simulation to sustained operation.(18)

A fourth, cross-cutting gap concerns the evaluation of equity outcomes, which are invoked more frequently than they are measured and which require indicators beyond trip counts, such as changes in realized access to employment and services for defined groups.(1,58)Closing these gaps would convert a literature that is rich in cases and models but thin in evidence of outcome into the evidentiary base that rural mobility policy currently lacks.

CONCLUSIONS

The literature between 2013 and 2024 characterizes demand-responsive transport in rural areas as a continuum of service models, from route deviation and feeders to fully flexible dial-a-ride, whose choice determines both operating cost and user uptake. The cost evidence shows that flexible operation beats the fixed route only below low demand thresholds and that financial sustainability depends on stable subsidy and on a modest willingness to pay. The outcome evidence is asymmetric, with persistent weak acceptance and narrow user bases set against a strong but under-measured accessibility and equity rationale. Policy and governance conditions, above all institutional continuity and earmarked funding, predict which services survive, while regulation still treats demand-responsive transport as a marginal mode.

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