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BOLOGNA LIVING LAB - Study on DRT costs and the possibility of their inclusion in the Service Contract, referring to DM 157 of 28/03/2018 (Standard costs)

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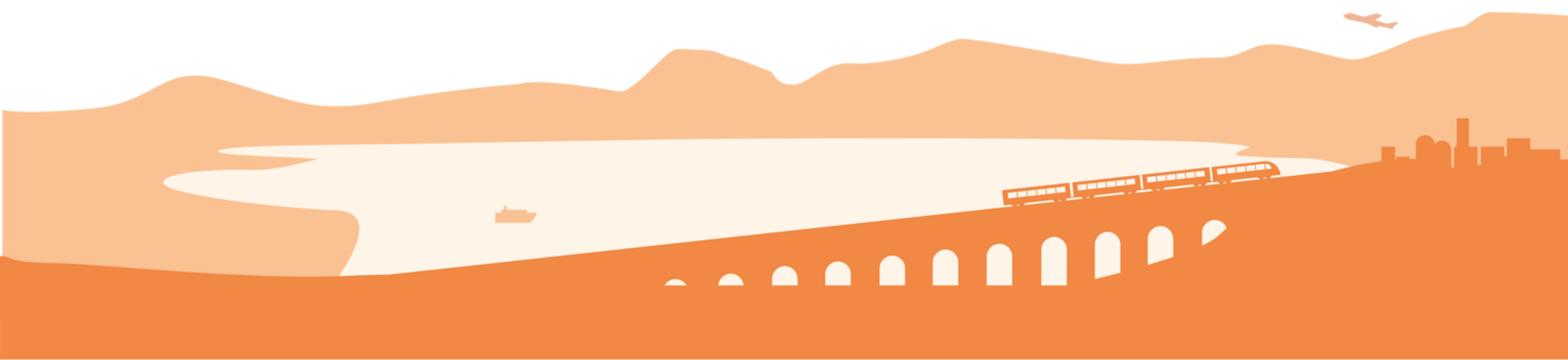

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Contents

1. Introduction

The objective of this paper is to **analyze the costs of DRT services**, identifying **criteria for a remuneration model** consistent with the standard cost system and the operational specificities of this type of service. The study also describes some useful elements to guide the **inclusion of DRT services in** Public Transportation **Service Contracts**, analyzing in particular economic sustainability and conditions of applicability. DM 157/2018 is used as a reference for cost analysis, with the aim of evaluating methodologies applicable to DRT and identifying criteria for its framing within the industry's remuneration models.

DRT (*Demand-Responsive Transport*) **services** are a particular form of *Flexible Transport Service* (FTS) that can be activated only on demand; they are not active when the mobility demand is absent, and they are dedicated to collective transport; specifically, DRTs include solutions without fixed patterns, which adapt routes and schedules to user demand with configurations that effectively meet spatial needs, articulating on three dimensions:

- *Routes and Times*: range from predefined routes with partially fixed schedules to totally flexible routes, optimized in real time.
- *Booking Modes*: range from direct access without reservation to immediate or scheduled booking, with different levels of planning.
- *Network Types*: depend on routes and stops, and are divided into:

  - **Networks with fixed routes and stops**, following rigid patterns;
  - **Networks with flexible routes and fixed stops**, adaptable to mobility demand but with predefined stops;
  - **Fully flexible networks** with variable routes and stops according to the demand.

In summary, DRT is distinguished by:

- **Operational flexibility**: the service is not rigid but adapts to actual user demand and can vary in real time, being particularly effective in contexts of weak or variable demand, such as rural areas, suburban territories, decentralized locations, or time slots with low ridership. *This flexibility of service makes the measurement of standard costs based solely on the concept of "ride-km" inadequate*;
- **Variable cost dynamics:** the DRT, depending on the type of network applied, may not have fixed routes or predetermined frequencies, so *costs are affected by daily variability of factors* such as demand density, distances traveled, waiting times, and number of passengers carried;
- **Diversity in operating models**: the DRT can operate with reservation in advance, in real time, on variable routes, or with collection points, requiring a *costing approach that takes into account the combination of multiple operating factors*;
- **Greater incidence of management and technology costs:** the DRT requires advanced reservation management systems through mobile applications, route optimization algorithms, and a dedicated IT infrastructure, *as elements that must be considered in the service remuneration model*.

The specificities of the DRT and the need for a dedicated model

Given their specificities, **the definition of a remuneration model for DRT services presupposes the adoption of a calculation method that allows their framing within the local public transport system**; at the same time, however, **the absence of a methodological reference and specific experience makes it complex to quantify the costs of DRT services in a manner consistent with other modes of public transport.**

In fact, as is well known, Ministerial Decree No. 157 of March 28, 2018 introduced the "***standard cost***" system for local and regional public transportation services, using specific methodologies for different modes of transportation:

- *Linear regression method*, applied to bus and railways;

- *Analytical method of calculation*, used for tramways and subways.

Although Art. 3(3) of DM 157/2018 provides for the use of the analytical method for services for which the regression method cannot be used, Art. 3(6) explicitly excludes on demand services, including DRT services, without defining an alternative economic method for their quantification.

This can be considered a **useful starting point for the development of a coherent standard cost system applicable to DRT services**, consistent with their operational characteristics and through a system that takes into account the specific processes and industrial activities related to their delivery. **This consideration, therefore, introduces the need for an alternative method that is more adherent to the flexible nature of DRT and its operational variability**.

Limitations of the classical model of remuneration per km for DRT

Given the purpose of identifying a model that complies with the efficiency and cost-effectiveness criteria of DM 157/2018, adapted to the specifics of the DRT, and that can be integrated into Service Contracts, it is inevitable to observe how the direct application of the classic mileage remuneration model entails a number of limitations for DRT services that depend on factors such as:

- **the amount of miles traveled varies daily**, without necessarily reflecting greater or lesser operator effort;
- **the operator must ensure the availability of the vehicle regardless of the mobility demand**, implying costs even when the vehicle is not in motion;
- **a model based only on distance traveled does not incentivize the efficient use of resources**, because an operator who optimizes routes to minimize travel would risk reduced remuneration.

The following Table 1-1 sets out the main elements of incompatibility between the traditional model and the operational and management nature of the DRT:

	Description of the limit
Variability of demand	Demand in the DRT is discontinuous and affected by temporal (schedules, seasonality, etc.) and spatial factors: it often operates in areas with low density or weak demand
Risk transfer	Remuneration occurs only if the vehicle is in active service
Unrecognized fixed costs	The DRT requires constant availability of vehicles and personnel, even in advance reservation models, regardless of actual rides
No-load transfers	In DRT services, the miles traveled to reach the user's pickup point do not coincide with an authorized "fixed" route and may not be counted as service miles in the classic mileage model
Efficiency penalized	DRT optimizes routes by reducing km and consolidating the mobility demand. But the km-based model remunerates more less efficient services (more km = more compensation).

Table 1-1 Limitations of the classical model of remuneration per kilometer in its application to DRT services

2. Elements of operating cost in DRT services

This chapter is devoted to **describing the** typical **operating cost elements** of this type of service.

A first, a relevant distinction is between **fixed costs** incurred regardless of the level of service provided and **variable costs**, which are linked to the actual operation of the service, depending on the kilometers driven, the hours of driving and the number of requests served. Therefore, this classification allows for a functional representation of the economic structure of the service, highlighting components with rigid versus modulable incidence. In the specific context of weak demand settings, where the weight of fixed costs can significantly affect the economic sustainability of the service, the distinction between fixed and variable costs is even more relevant.

For the purpose of providing a review of the main items, in the following paragraphs the analysis is organized by macro-families of costs, with the aim of classifying each cost element as fixed or variable based on technical and operational criteria.

2.1. Fixed operating costs

Fixed costs are the expense items that include all the resources that must be maintained on an ongoing basis to ensure basic operational capacity, regardless of the actual volume of service provided. In DRTs, their incidence can be high, as the service may be in idle condition or with a very low number of requests. A number of "**major macro-families**" are distinguished below:

Analysis and study costs

DRT services generally have a different complexity if compared with fixed-line services, generating higher assessment costs. These costs are generally absorbed by existing dedicated facilities.

Staff

This family includes **personnel directly and permanently involved in service delivery** on the basis of scheduled shifts or guaranteed attendance, including:

- **drivers assigned to the service**: a typically fixed item, as they are contracted according to predefined schedules (CCNL TPL) and paid for availability, not for rides made. Even in flexible DRT models, unless outsourced, their presence must be ensured. In the more flexible service models, drivers may already be operating in the territory for other activities (NCC or TAXI) but must still provide minimum availability that needs compensation; also to be adequately considered are the long pauses between rides that are non-productive waiting times between two consecutive services, due to gaps in demand, distance between points served, or time mismatch between requests. Although they are part of the fixed costs of driver compensation, they represent a consumption of resources that should be properly considered to maximize operational efficiency;
- **operational coordinators/local contact persons**: figures in charge of overseeing the service during operation, with tasks of monitoring operations, supporting the driving staff and managing any critical issues on the ground. They can intervene in case of anomalies, coordinate response to unforeseen situations, or facilitate interaction between vehicles on the road and the central management structure;
- **possible Operations Center staff:** if the system includes a human supervision component, such as telephone assistance or direct management of reservations via call center. The resources employed should be considered a structural fixed cost, as they must man the scheduled service time slots, regardless of the number of calls or rides actually handled. Sizing depends on the service model and the level of digitization of user interaction.

The “weight” of these items depends on the **type of DRT service**: in fixed-route or extended-coverage models, driving staff must be guaranteed regardless of the number of users. Only in fully on-demand and outsourced management models the fixed fee can be reduced, but this involves different structural choices.

Vehicle fleet and maintenance

This macro-family includes the costs required to keep a ready-to-operate fleet of vehicles active and consists of two distinct but interconnected components. The first relates to **vehicle availability**, understood as the minimum condition to ensure service activation, considering expense items such as:

- **Leasing** or **depreciation of** assets;
- taxes, insurance, ownership tax;
- Storage or parking **fees;**
- Availability of **spare means** to cover failures or unforeseen changes in demand.

The second component concerns **scheduled** and mandatory **maintenance.** These costs are independent of actual mileage, since they are defined by regulations, technical manuals or service standards. Even a sparsely used vehicle must undergo the scheduled interventions, which has a direct impact on the fixed annual cost per available unit:

- **cyclic servicing** as prescribed by the manufacturer (e.g., coupons, filter replacement, brakes, belts);
- Periodic reviews and **safety audits**;
- **Agreement** services (e.g., full service, subscription workshop).

Digital technologies and platforms

This macro-family includes all the technological components necessary for operational management of the service, both on the user side (reservation, confirmation, information) and on the manager side (monitoring, vehicle assignment, shift management). These are central tools in DRT services, necessary for organizing the flow of requests, monitoring the status of the service, and dynamically optimizing the distribution of vehicles across the territory.

Digital platforms can be acquired primarily in two ways: the first involves **third-party provision**, in *Software as a Service* (*SaaS*) mode in which the platform is granted for use through a **recurring fee**, usually on a monthly or annual basis, commensurate with the number of active vehicles or usage profile. The **costs** can be classified as fixed, **as they do not vary with the actual number of rides or bookings**. There may be contractual thresholds (e.g., maximum number of vehicles or requests that can be handled), but any price brackets do not change the structural nature of the item. This mode includes:

- fees for the use of the digital platform, including the user app, driver interface and operational management tools;
- user licenses, reservation services, upgrading, technical maintenance, and information security;
- Shift monitoring and management tools, including real-time tracking and visualization of rides.

In free-flow DRT services, the platform must also include **dynamic route recalculation** functions that allow real-time optimization of the sequence of stops and the distribution of rides among available vehicles, depending on the reservations received and their temporal evolution. This capability, which requires specific multi-passenger optimization algorithms and compatibility with operational constraints (vehicle capacities, time slots, distances), is **one of the most relevant components of the digital system** and justifies the presence of **fixed fees or price brackets commensurate with the complexity of the allocation logic built into the software.**

Alternatively, the operator can **develop or acquire in proprietary form its own platform.** In this case, a **higher initial cost** is incurred, including functional analysis, design, development, and testing phase. On the other hand, once implemented, the platform generates low recurring costs related to routine maintenance, regulatory and technological updates, and any functional adaptations.

Technologies include communication systems between the central system and the driver/vehicle necessary to communicate planned activities; this system must consider the quality of signal coverage and available on-board or personal equipment. In cases where coverage is not available, provision can be made for shift communication at a fixed point (driver's home the day before or depot prior to exit) but affecting the advance booking.

Overhead and logistics

Included in this macro-family are all items of indirect support, but essential for the operational continuity of the service, including:

- **Operational headquarters**, offices, logistics space and warehouses, including shared;
- **marketing of travel tickets** includes reseller fees or participation in MaaS platforms that provide for the sale of travel tickets;
- **utilities, maintenance, housekeeping, security**, where applicable;
- Non-vehicle-related business **insurance** (liability, third-party damage, cyber-risk);
- **administrative** and accounting **functions**, including reporting activities to the awarding agency;
- institutional **communication**, customer care, information materials and user tools; participation in MaaS platforms that communicate services.

These costs are generally **stable over time**, and do not vary with the number of rides or users. Where operators operate multiple services, these items may be allocated on **a pro-rata** basis, according to agreed allocation criteria (e.g., number of vehicles, shifts, economic weight of the service).

Summary of fixed operating costs

Macro-family	Cost item	Operational requirement	Operational Notes
Analysis and study	Surveys and service evaluations	Different complexity than regular line items	These costs are generally absorbed by existing dedicated facilities.
Staff	Drivers assigned to the service	Mandatory contractual availability (CCNL TPL), independent of rides made	In flexible models, they can operate multiple services (e.g., NCC, Taxi), but they must guarantee a minimum availability that needs compensation
Staff	Operational coordinators/local contacts	Monitoring of operations and real-time management of any critical issues	Stable figure, also useful in flexible models without continuous centralized supervision
Staff	Operations center / call center personnel	Guaranteed presence to cover interaction with non-digitized or assisted users	Constant in active time slots, modulated by service digitization
Vehicle fleet and maintenance	Leasing/amortization	Contract on an annual or multi-year basis, independent of use	Number of vehicles depends on hourly/geographic coverage
Vehicle fleet and maintenance	Insurance / tax disc	Fixed expenses per registered vehicle	Higher costs for special vehicles (e.g., 4x4, high accessibility)
Vehicle fleet and maintenance	Storage / parking	Constant fee, often on a monthly basis	Possibly shareable with other services

Macro-family	Cost item	Operational requirement	Operational Notes
Vehicle fleet and maintenance	Means of escort	Mandatory to ensure continuity in case of failure	They affect even when unused
Vehicle fleet and maintenance	Scheduled maintenance	Cyclic interventions independent of mileage	Mandatory by regulation and warranty
Digital technologies and platforms	Software fees, apps, management tools	SaaS contract or annual license, not dependent on rides made	Cost jumps only over thresholds (e.g., no. vehicles); includes central-driver communication, taking into account coverage and available equipment
Digital technologies and platforms	Path recalculation algorithms	Integrated function in the digital system, to be guaranteed for free-flowing DRTs	Central element in DRT logic, with impact on license price
Overhead and logistics	Marketing of travel tickets	Physical or digital ticket sales network and integrated channels	Includes resellers' premium or fee for MAAS platforms
Overhead and logistics	Communication, customer care, information	Presence of materials and information channels for users	It also includes participation in MAAS platforms that communicate services
Overhead and logistics	Operational headquarters, utilities, insurance, administration	Fixed structure to be kept active regardless of the level of demand	Possible pro-rata allocation if the operator covers multiple services

Table 2-1 Fixed operating cost summary

2.2. Variable operating costs

Variable operating costs are the expense items that **vary in proportion to the level of service provided** and are therefore triggered only in the presence of rides, kilometers traveled and reservations handled, thus being closely linked to the actual demand and mode of operation of the service.

Some items are directly proportional to the activity performed (e.g., fuel, maintenance due to wear and tear), others depend on efficiency factors and how demand response is organized (e.g., canceled rides, service breaks, reservation management).

Exercise and consumption

This macro-family includes cost items that are activated only when service is performed. They are proportional to miles driven, hours driven, or actual operating intensity:

- **mileage-related costs**, which include fuel or traction energy, materials subject to wear and tear (e.g., tires, brakes, lubricants), and extraordinary maintenance related to intensity of use. These costs vary with fuel technology, terrain morphological conditions, and service profile, and are increasing with average fleet age and actual operational use;
- **hours of availability and/or driving**, in cases of very flexible services (very low demand), the driver is activated and paid only in case of activation in which case the driving hour constitutes variable cost;
- **overtime hours of driving personnel**, which result from exceeding planned shifts in case of peak demand, congestion or organizational inefficiencies. Their incidence varies according to the quality of planning and the flexibility of the operating model adopted.

These costs are particularly relevant in DRT services operating over an extended operational area or in free-flow types, where vehicles are exposed to greater operational variability and less predictable conditions of use than in rigid-route services.

Information technology and systems

Digital platforms used in DRT services represent, in their basic configuration, a fixed cost. In some contract models, however, there is a **variable component**, linked to the actual use of the platform:

- **Incremental costs beyond contractual thresholds**: some SaaS providers may have predefined thresholds (e.g., maximum number of connected vehicles, number of monthly requests) beyond which additional costs are applied. In these cases, the excess becomes a cost proportional to the volume of service performed;
- **consumable services**, when certain platform features generate costs only when activated such as sending SMS notifications, electronic transactions, particular user support tools, or modules added for particular seasonal point-of-interest management (e.g., ski resorts, spas) or for reporting functions. Although marginal to the total, these items can have an impact in high user interaction scenarios.

This variable component should be considered in scenarios characterized by **increased demand, extension of service hours, or activation of new vehicles**, which may generate non-negligible extra costs compared to the base configuration. In economic planning, it is useful to estimate progressive usage scenarios to avoid underestimates in the case of operational expansion or service extension. In addition, **the level of digitization of the system and the availability of human oversight for managing reservations** (e.g., call center) can affect the variable cost structure; in fully automated models, this item is marginal while, on the contrary, in mixed services or those with a strong assisted component, it can represent a significant share, especially in the presence of fragile users or those with difficulties in accessing online channels.

Inefficiency and adaptations

This macro-family collects costs that do not result directly from the productive activity of the service, but from **deviations from ideal operation.** These are items that are triggered when demand is discontinuous, unpredictable, or poorly distributed, and can significantly affect overall efficiency, such as **uncompleted rides due to late cancellations or user absence** - when a user cancels a ride at the last minute or fails to show up, uncompensated costs are generated: empty miles, lost time, inability to reallocate the vehicle in a timely manner.

The incidence can be significant in individual call models, in the absence of a mandatory user confirmation mechanism or penalty tools. In many contracts, this type of ride is nevertheless remunerated by the contracting station, as it is considered part of the service made available, according to logics compatible with the remuneration model adopted;

These components are particularly relevant in DRT services operating in areas with irregular demand, where fragmented travel and the inability to fully optimize routes result in an **implicit efficiency loss**, which must be considered when estimating variable costs.

Summary of variable operating costs

Macro-family	Cost item	Operational requirement	Operational Notes
Exercise and consumption	Mileage-related costs	Dependence on the distance covered by the vehicle, even without passengers	Include fuel, wear materials and maintenance proportional to use
Exercise and consumption	Hours of availability and/or driving	Activation only on demand in very flexible models	Variable costs in the presence of timely activation, in contexts of weak demand
Exercise and consumption	Overtime hours of the driving staff	Exceeding planned shifts	Linked to peak demand or other externalities

Macro-family	Cost item	Operational requirement	Operational Notes
Information technology and systems	Costs over SaaS contract thresholds	Exceeding limits included in the base fee	Can activate with multiple vehicles, requests, or area served
Information technology and systems	Consumer services (SMS, transactions, forms)	Optional activation of advanced features	More relevant in digitized and tourism contexts
Inefficiency and adaptations	Unfinished rides (cancellations/absences)	Reservation not respected	Race often recognized in the contract anyway

Table 2-2 Summary of variable operating costs

2.3. Considerations

The operational cost elements identified in the preceding paragraphs may behave differently depending on the **DRT service model adopted**. Some items are configured as structurally fixed in each scenario, while others take on a variable nature, changing their weight or behavior depending on the degree of demand, the presence of minimum guaranteed shifts, or the mode of interaction with users. For example, **driver staffing** tends to be a fixed cost in fixed-route models, but may take on a more variable nature in ultra-flexible services or in low-demand contexts, where drivers are activated only when needed. Conversely, **driving hours can become a pay-as-you-go cost, just as hours of availability can be compensated based on activation**. Similarly, the **reservation system** has a basic fixed component, but can generate additional costs if the volume of requests or the area covered grows, especially with non-digitized users or assisted channels activated on demand.

One management choice that significantly affects the cost structure is that related to the **technology platform**: acquiring software on an "*as a service*" basis implies a recurring fee, generally fixed but scalable; **in** contrast**, in-house development or proprietary acquisition** involves a significant initial investment but can ensure a **significant reduction in variable costs** over time, limited to maintenance, upgrades and functional adaptations. In multi-year tenancies, this choice can foster economies of scale and greater technical control over reservation management and dynamic route recalculation.

The fixed/variable classification is therefore neither rigid nor definitive, but must be **read from a dynamic perspective**, evaluating **the temporal evolution of the service** and its possible expansion. Elements such as the progressive degradation of vehicles, contractual updates provided for in the CCNLs, or optimization of shifts and routes through operational experience can change the weight and configuration of individual items over time. For this reason, it is necessary that the cost analysis is not limited to an initial snapshot but is structured to **account for evolving dynamics**, so as to ensure the sustainability and economic balance of the service throughout the contract term.

3. DRT service remuneration models alternative to the standard cost method

As mentioned earlier, in order to identify a reference element for the quantification of economic compensation and fees to be put on the auction basis of local and regional public transport services, Ministerial Decree No. 157 of March 28, 2018 introduced the system of so-called ***standard costs***, using specific methodologies for different modes of transportation:

- *Linear regression method*, applied to bus and railways;
- *Analytical method of calculation*, used for tramways and subways.

Although Art. 3(3) provides for the use of the analytical method for services for which the regression method cannot be used, Art. 3(6) explicitly excludes on demand services, including DRTs, from this subset; it should be noted, however, that the decree does not provide an indication of an alternative economic method for their quantification.

That being said, it should be specified that the application of the classical model of remuneration based on distance traveled (€/km) to DRT services is not always adequate because it does not consider the possible operational characteristics of a flexible service, in which travel distances vary according to demand and the vehicle must be available regardless of actual use. In this context, the distance traveled is not a fixed parameter, but a consequence of user requests and the operational organization of the service.

In summary, the application of the mileage criterion to the DRT has objective application limitations that can be summarized by the following **three main critical issues**:

- the operator has to incur fixed costs to ensure the availability of the service (vehicles, drivers, IT infrastructure), but is only remunerated for the kilometers traveled, which can generate **economic imbalances** and undermine the sustainability of the service;
- the mileage model incentivizes **longer rather than more efficient routes**, penalizing those who optimize service to reduce empty mileage;
- remuneration per km may cause operators to limit coverage in areas of inconstant demand, reducing the very flexibility that is the added value of DRT.

3.1. DGR Lombardy No. X/4927/2016

To overcome these limitations, **alternative criteria** have been developed **for quantifying the volume of service provided in DRTs**, including the "***equivalent mileage***" system, introduced by Lombardy Regional Executive Resolution No. X/4927 of March 14, 2016. The aim is to **adopt a mechanism to measure the volume of DRT service in a standardized value of distance traveled**, making it comparable with scheduled public transport and providing a uniform basis for determining the economic compensation of flexible transport services.

As a conceptual premise, it should be specified that **the Lombard model does not directly define the remuneration of operators, but provides a criterion for converting DRT service activity into a standardized quantity of mileage.** The ***Peq*** therefore serves as the basis for calculating the economic consideration due to the operator and is **used to calculate the remuneration, applying a "*unit cost*"** determined according to the criteria established by DM 157/2018.

The approach adopted is based on equivalent mileage (referred to as "equivalent mileage"), **which transforms the service time made available, into a value expressed in kilometers, through the application of an average commercial speed and correction coefficients.** This method allows DRT services to be integrated into local public transport service contracts, ensuring payment criteria consistent with those adopted for scheduled services.

The equivalent distance system introduced by Lombardy Regional Decree No. X/4927 of March 14, 2016 is applied to the different operating configurations of DRT, which differ in route structure, the presence or absence of fixed stops, and booking methods.

DRT network type	Service time table	Method of reservation
Service to basic routes and fixed stops	Scheduled and modifiable schedules with limited advances/postponements	Off-line
Base-route service, with the possibility of detours and fixed stops	Unscheduled hours	Combined Off-line/On-line
Free-route service between a predefined set of points	Unscheduled hours	Combined Off-line/On-line
Service to free routes between any set of points	Unscheduled hours	Combined Off-line/On-line

Table 3-1Type of Service - Time Table - Booking Mode. Source: ANNEX A- CONVERSION OF SERVICES'S SUPPLY "ON CALL" IN EQUIVALENT PERFORMANCE, DGR Lombardy X/4927/2016

Booking methods are distinguished into:

- **Off-line**, with booking made before the start of the duty shift and centralized management of requests;
- **Combined Off-line/On-line**, which can enable reservation requests to be captured even while in service, reprocessing them in real time.

This articulation allows equivalent mileage to be determined **in** a manner consistent with the operational characteristics of each service. In particular, the way in which the service is booked and organized affects the availability required of the operator and the variability of the route, which are key aspects in converting hours of service into equivalent mileage.

Peq is calculated according to different methodologies depending on the type of network adopted by following three key parameters:

- **the hours of vehicle and personnel availability (*OREus*)**, which represent the actual time the service is active;
- **the average commercial speed (*Ve*)**, used to convert service time into a standardized measure of travel time;
  - ***Ve*** is **between** 17 and 20 km/h for **urban services**;
  - ***Ve*** is **between** 27 and 33 km/h for **suburban services**.
- An **adjustment coefficient (*c*)**, which considers the actual operation of the service and the probability of actual delivery.

For "basic route services and fixed stops."

$$Peq = Pprog$$

Where:

- ***Peq*** "equivalent mileage for contract purposes" are the equivalent mileage to which the unit fee should be applied;
- ***Pprog*** "scheduled mileage" are the mileages that the service operator makes available for the implementation of DRT services in lieu of scheduled services

According to the Lombardy Region's proposed model for this type of DRT, the equivalent mileage for contractual purposes coincides with the scheduled mileage, without the need for conversions.

This means that, **in terms of calculating the unit fee**, these services are treated in the same way as ordinary scheduled services, **without recognizing any management or operational specificity**. This is a critical point in the current approach, which deserves attention when revising the model, as it **does not value the**

structural differences between DRT and traditional LPT, nor the costs associated with flexible demand management.

For "basic route services with detours and fixed stops" and for those with "free routes between predefined points."

$$Peq = OREus \times Ve \times c1$$

Where:

- ***OREus*** are the "driver+vehicle service unit hours" actually made available in the daily service span;
- ***Ve*** represents the average commercial speed of the service (km/h);
- ***c1*** is a correction coefficient that takes into account the probability of actual service delivery and the higher unit operating costs compared to scheduled services, and in the present case is a value between 0.80 and 0.85.

This method accounts for **greater operational variability than fixed-route services** by recognizing an equivalent number of kilometers that considers actual service time.

For "free-route services between any set of points."

$$Peq = OREus \times Ve \times c2$$

Where the variables are similar to those expressed above while ***c2*** is a higher coefficient (between 0.90 and 0.95), reflecting **higher operating costs and lower service predictability**.

For services activated "*with digital reservation*" (online):

$$Peq = OREus \times Ve \times c^{1} \times 1{,}2$$

In this case, an **additional multiplier of** 1.2 is applied **to incentivize the use of digital** booking **tools** and improve service efficiency.

3.2. Possible developments

In terms of what has been said so far, the remuneration model based on ***equivalent distance traveled***, introduced by Lombardy Regional Executive Resolution No. X/4927 of March 14, 2016, is a first technical-operational reference within the regional regulation of local public transport. In its "*Coordination Guidelines for the awarding of LPT service and the drafting of service contracts*," the Lombardy Region has defined a criterion for converting DRT into a unit of measure comparable with scheduled services, providing **a useful starting point for the integration of DRT into service contracts**, although **this Resolution does not represent current legislation at the national scale**.

The proposed methodological framework is consistent with the logic of standard costs and allows for parameterization of operators' activities although it has some critical application issues: the equalization between fixed-stop DRT and traditional scheduled services does not enhance the managerial specificities of DRT, while the use of an insufficiently structured "*c*" coefficient limits the model's ability to represent actual operating conditions.

[1] "***c***" takes a value of "***c1***" for basic-route services with fixed detours and stops and for those with free routes between predefined points, while it takes a value of "***c2***" for free-route services between any set of points.

Precisely with a view to providing potential useful references for dealing with such critical application issues, the following paragraphs discuss some possible evolutions for developing alternative criteria for quantifying the volume of service delivered in DRTs.

Overcoming the equating of DRT service "*with basic routes and fixed stops*" with scheduled LPT

For *DRT services* operating on predefined routes and stops, equating them with scheduled travel does not adequately represent the reservation-based nature of the service.

One possible evolution of the model is to reclassify this configuration to what is provided for the "*fixed lines with detours and fixed stops*" typology. Such a reclassification would make it possible to overcome the assimilation to scheduled LPT, through a correction coefficient that takes into account demand-conditional activation, thus maintaining a basis for calculation consistent with standard cost logic, but adapted to the managerial specificities of the service.

The introduction of a **theoretical activation coefficient**c_0 can promote recognition of the value of the organization and guaranteed availability, while avoiding an overestimation of the recognized mileage compared to the actual service performed.

Adaptation mechanisms for "*basic route* services *with detours*"

The approach proposed by the Lombard model for the calculation of *Peq* **does not distinguish between configurations with low and high incidence of deviations** on the base path, treating even very different cases uniformly. Integrative **mechanisms** can be introduced to improve the adherence of the calculation to actual operations:

- a first assumption involves the **application of an adjustment coefficient to the scheduled** mileage, based on the historical average of observed mileage deviations;
- a second way is to **introduce a variable component at the end of the day**, calculated on the actual kilometers more than the base route.

Both options tend to rebalance the relationship between theoretical availability and actual operational commitment, while maintaining the principle of contractual predictability.

Uniform correction coefficients for broad categories of service

The model has two average correction coefficients (*c1 and c2*) applied to basic-route services with fixed detours and stops and free-route services between predefined points (*c1*) and free-route services between any set of points (*c2*), respectively. This approach, while simplifying the calculation of equivalent travel distance, **does not distinguish between the different levels of operational and management complexity** that may exist within the same network types. In the case of weak-demand services, the level of effort required to deliver the service can vary significantly depending on factors such as:

- The frequency and mileage incidence of deviations from the base route;
- The territorial extent of the area served and its morphology;
- The hourly pattern of service (evening, holiday, night coverage);
- The technological level of the management system (digital platforms, optimization algorithms, advanced user interfaces).

These variables, while directly affecting the organization and costs of the service, are not reflected in the adopted correction coefficients, and this may result in an incorrect estimate of the recognized equivalent volume when determining the *Peq*, with consequent distorting effects on the operator's remuneration.

In a logic of greater adherence to the actual management, **the value of the coefficient *c* could be determined ex ante on the basis of objective parameters detectable at the service planning stage**. In this way, while maintaining the simplicity *of Peq* calculation, an element of greater customization and proportionality would be introduced; the coefficient could therefore be structured according to a composite logic:

$$c = c_{base} + \Delta_{flexibility} + \Delta_{technology}$$

Where:

- c_{base} represents the reference value for the category;
- $\Delta_{flexibility}$ reflects the expected intensity of detours or route variability;
- $\Delta_{technology}$ considers the level of digitization and automation of the management system.

This *c-value*, which is defined in the contract, would remain constant throughout the contract period, unless expressly provided for updates in case of significant changes in the service.

Presence of a single technological corrective, applied indiscriminately

The Lombard model provides for the application of a **multiplicative coefficient of 1.2** for the calculation of *Peq* in cases where the service is activated through a digital platform (**web or app booking**). This is a corrective designed to enhance the contribution of technologies in service optimization. This mechanism is applied **uniformly**, without distinguishing between the different technological configurations that can be adopted by operators:

- Integrated systems with digital payment tools and real-time routing algorithms;
- Intelligent booking platforms with advanced user interfaces;
- call center with extended coverage or mixed online/offline management;
- solutions based on manual or poorly digitized tools.

In the face of this heterogeneity, **the application of a single standard correction does not allow for the true differences in costs** incurred in implementing and managing service technologies to **be reflected**. One possible evolution may be to provide, at the contractual level, a **breakdown of the coefficients according to the level of technology actually adopted**. For example, specific adjustments could be introduced for:

- Automatic route optimization systems;
- Digital platforms with real-time tracking;
- Reservation channels with continuous telephone presidium.

Absence of a service performance-related component

The model proposed by the Lombardy Region does not provide for any direct recognition of service quality since the economic consideration recognized to the operator is determined exclusively on the basis of the volume of service available (*Peq*), without any modulation linked to indicators of efficiency, operational regularity or user satisfaction. However, this approach runs the risk of not valuing virtuous operations, uniformly treating services with even very different levels of quality.

To overcome this limitation, it may be appropriate to introduce a **quality coefficient**, to be applied **when calculating the final fee** (and not directly on the *Peq* calculation), that values the operator's operational performance. The coefficient, to be contractually defined, can vary within a predefined range and be activated if certain service quality thresholds, measured through objective indicators, are met. Such **performance indicators (KPIs)** may include, for example:

- The percentage of correctly fulfilled requests compared to the total received;
- The regularity of the service in relation to booking times;
- The degree of asset utilization, relative to available capacity;

- The quality perceived by users, detected through periodic monitoring tools.

The quality coefficient (α) once activated, enters the fee calculation formula according to the following expression:

$$Final\ payment\ = Peq\ \times Unit\ Cost\ \times (1 + \alpha)$$

Where α represents a reward factor, whose magnitude and trigger thresholds are defined in the service contract, also depending on the operating environment and local policy objectives. A mechanism of this magnitude makes it possible to reward efficient operations, without altering the basic function of *Peq* as a measure of service volume, by introducing quality elements within the economic structure of the contract.

Uniformity of costs in the face of different operating environments

The economic value applied to each *equivalent km* tends to be homogeneous, even with services with profoundly different cost profiles. Particularly onerous operating conditions, such as service coverage during evening, night or holiday hours, can also be considered in defining the unit cost applied to *Peq*. These situations entail a higher incidence of fixed and availability costs (personnel, vehicles, rostering), and their timely recognition can help ensure a sustainable economic balance for the operator, especially in contexts of weak demand.

Although Lombardy DGR No. X/4927/2016 differentiates the average commercial speed between urban (17-20 km/h) and suburban (27-33 km/h) services, this parameter only acts on the calculation of *Peq*, affecting the amount of travel recognized but not the economic value assigned to each equivalent kilometer. **Therefore, the unit cost applied to *Peq* tends to be uniformly defined in service contracts, without fully considering the actual cost structure of different contexts**.

It is easy to deduce, in fact, how DRT services operating in mountainous areas, during evening or holiday hours, or in territories with very low population density, present significantly different operating costs than those exercised in urban daytime or high aggregate demand areas. In these scenarios, a possible development may be to **differentiate the unit cost applicable to *Peq***, based on objective and contextual parameters, such as:

- services in mountainous or suburban areas with low density and high spatial dispersion;
- night or holiday services, involving additional shifts and higher incidence of unproductive hours;
- services with very low demand, with very high fixed costs relative to the miles driven.

One solution could be to differentiate the unit cost of *Peq* by applying **parametric grids based on the type of service and operating context** to recognize a value more consistent with the costs incurred.

Such articulation could help improve the fairness of the remuneration system, ensuring a better fit between the costs incurred and the remuneration recognized, especially in services operating under conditions of greater operational fragility or with a territorial garrison function.

Alternative approach based on hourly value of service

In contexts of weak demand, characterized by high spatial dispersion, low demand density and high incidence of fixed costs, the determination of economic compensation through a mileage-only parameter may not be fully representative of actual operational effort.

An alternative methodological option is to calculate the hourly value of DRT service from existing contract parameters. Specifically, given a local public transport contract expressed in €/km and knowing the average operating speed of the service (km/h), it is possible to derive the base value of an hour of service:

$$€/h_{DRT} = \left(\frac{contract\ cost\ \ €/km}{avarange\ speed\ \ km/h}\right)$$

Parameterized adjustments can be applied to this hourly value to adapt it to the specific service configuration:

- A reduction factor when using light vehicles or vehicles with lower depreciation costs;
- a surcharge related to the presence of advanced technological infrastructure for service management (digital platforms, automatic routing systems);
- an additional increase to cover the costs of more onerous booking channels, such as dedicated call centers or extended telephone support.

The overall formula can then be represented as follows:

$$€/h_{DRT} = \left(\frac{contract\ cost\ €/km}{avarange\ speed\ \ km/h}\right) - \%\Delta cost + \%technology\ platform\ cost + \%call\ center\ cost$$

In the formula the **depreciation differential** is **subtracted** because the €/km reference value comes from traditional LPT contracts, in which depreciation costs refer to large buses, typical of high-capacity lines. In DRT services, on the other hand, especially in areas of weak demand, smaller vehicles with lower acquisition costs are used, necessitating a downward adjustment of this component. Conversely, the adoption of **advanced technologies for service management**, such as digital reservation platforms, route optimization algorithms, or dedicated call centers, introduces **new cost items** that are not covered in traditional line contracts, and thus must be considered as **surcharges** on the standard hourly value.

This methodology allows for an **estimate that is more closely aligned with the actual costs** incurred by the operator, proving particularly useful in contexts in which a theoretical service mileage cannot be defined a priori, such as in fully flexible DRTs or those operating at marginal times and territories. In addition, the adoption of an hourly parameter makes it possible to **stabilize remuneration**, partially decoupling it from the volume of kilometers traveled and recognizing the value of **service availability**, even in the presence of discontinuous demand.

Mixed models for very low demand services

In some specific spatial contexts, such as rural areas, mountainous municipalities, or marginal time zones, transportation demand may be so discontinuous that even the *Peq-based* model is inadequate. In these cases, the operator must ensure service availability against a very limited number of rides or requests actually met, with a high incidence of fixed costs.

One possible configuration in such scenarios is the adoption of a mixed remuneration model, structured on two components:

- **a fixed fee**, parameterized on an hourly or daily basis, which remunerates the availability of the vehicle, staff and operations center, regardless of the kilometers driven;
- **a variable fee**, linked to the number of requests served, rides made or passengers carried, which values the actual activation of the service.

This scheme makes it possible to ensure the economic sustainability of the service even in the absence of high volumes of use, preserving the social and territorial function of DRT.

4. DRT service remuneration models applied in the Metropolitan City of Bologna

This section analyzes **four** demand responsive services (DRT) **contract models** activated by SRM in the Bologna Metropolitan City basin with the aim of documenting and comparing the different experiences in the area, including in terms of **remuneration model** configurations based on the contract clauses applied in the respective periods of operation.

The cases considered, which differ in their operational configuration, service activation methods and fee determination criteria, are:

- reservation service in the ***Borgo Panigale*** district (***Col☎BUS***, 2009-2010).
- ***ProntoBus of Pianura*** (as of September 15, 2011);
- ***Apennine ColBus*** (summer 2021 and winter 2021-2022);

The models are presented in comparative form, highlighting the characteristics of each service and its remuneration model.

4.1. Borgo Panigale District reservation service (Col☎BUS)

The Borgo Panigale Neighborhood Reservation Service was activated by SRM in 2009 with experimental purposes, as a **pilot project of Demand Responsive Transport in urban areas.** The service, active in Bologna, was aimed at undifferentiated users residing in a weak demand area, with the goal of facilitating **access to the LPT carrier network and the main public poles** in the neighborhood.

Operational configuration of the service

The Col☎BUS operated as a **variable-route** DRT service **with rides between predefined stops** and operated through a call center.

The service adopted a configuration of stops divided into two groups: "*central*" and "*widespread*." Rides were allowed between stops belonging to different groups, in an **adduction** logic **towards the carrier network and the main interchanges**. The articulation into groups of stops and the absence of rigid routes allowed operational flexibility, yet maintained controllable minimum service standards.

Remuneration model

The service contract adopted a **remuneration model** in which the operator assumed part of the responsibility for the economic sustainability of the service. The compensation structure included a **fixed fee** and a **variable fee** closely linked to ticketing receipts related to booked trips:

- the **fixed** annual **fee**, remunerated the guaranteed operational availability for the entire span of the service regardless of the number of rides actually booked;
- **the variable quota**, subject to a cap, depended on the ticketing revenue certified by the foster carer and referring only to booked trips.

In contrast to the full compensation models, tariff collection was valued and directly contributed to the calculation of the total fee. In this scheme, **the operator retained the traffic revenue** and assumed part of the commercial risk.

A distinctive feature of the contract concerned the **management of unreserved access**, i.e., passengers who spontaneously boarded: the contract stipulated that the operator had to accept them, consistent with capacity and the already optimized itinerary. **The income from** these users did not count toward the variable fee recognized by the contract, but **remained entirely at the disposal of the entrustee**. This generated a form of "**ancillary revenue**" that, while not formally valued in the contractual fee, contributed to increasing the overall economic return for the operator. In other words, each access without a reservation, while not affecting the recognized variable fee, contributed to enhancing the operational effectiveness of the service, improving the utilization rate of the vehicles and generating additional revenue for the operator.

Considerations

The Borgo Panigale Neighborhood Reservation Service introduced a contractual and operational configuration that was distinguished by the balance between managerial flexibility and regulatory oversight:

- from the point of view of **operation**, the **articulation between** "*central*" and "*diffuse*" **stops**, with constraints on crossing between groups, **represented a mechanism for directing demand to trips of greater functional relevance, avoiding localized or fragmented use**. The reservation system was complemented by a logic of access even without a reservation, consistent with the capacity of the vehicle and the defined route, providing greater flexibility and operational inclusiveness;
- In terms of **remuneration**, the contract adopted a **hybrid structure** in which the operator retained ownership of the fare revenue and assumed part of the economic risk. The variable portion of the fee was directly linked to ticketing revenue, while revenue from passengers who boarded without a reservation did not contribute to the determination of the fee, remaining at the disposal of the operator and constituting an ancillary revenue component.

Overall, **the remuneration model** adopted for the Borgo Panigale Neighborhood Reservation Transportation Service **combined elements of managerial flexibility** and **economic empowerment**. The operator was incentivized to maximize service utilization and ticketing, within a framework governed by well-defined contractual thresholds and limits; at the same time, demand-related risk was not fully transferred, making the system more **responsive to real demand** and geared toward sustainable use of public resources.

4.2. Pianura ProntoBus Service

The ProntoBus service in Pianura has been operated by SRM since September 2011, through a **supplementary contract to the service contract** for LPT bus services in the Bologna basin. The service was established to ensure **accessibility in the municipalities of the Pianura metropolitan area, which are characterized by low settlement density and dispersed demand**, and in which the activation of regular frequency rides is not sustainable from an economic-operational point of view.

Operational configuration of the service

The service configuration includes both:

- **reservation lines**, with a fixed route that can be activated only at the request of the user;
- **regularly exercised fixed lines**.

The service is configured to support **relationship mobility**, connecting smaller centers to interchanges and strategic destinations during peak periods. Operationally, drivers remain available on the entire scheduled time belt, with breaks built into the probability of non-activation of booked rides.

Remuneration model

The contract provides for a **fee** paid to the operator **in proportion to the actual mileage delivered**, with a full service compensation system. The value of the public **subsidy** is **commensurate with the share of kilometers performed** compared to the theoretical schedule, **according to a reference threshold**, on which the minimum and maximum compensation values are based. **Fare revenues** are retained by the operator and **do not contribute to the calculation of the fee**.

The total annual quota is determined on an assumption of a defined percentage disbursement of planned mileage by providing:

- a **maximum threshold of** consideration in the case of making 100% of the mileage;
- a guaranteed **minimum threshold** to cover the fixed costs incurred by the operator to ensure the continuous availability of the service.

Considerations

Pianura's ProntoBus contract provides for a **remuneration model linked to the service provided**, with remuneration commensurate with actual mileage and rides operated.

The model adopted focuses **remuneration on the activation of requested rides, regardless of the number of passengers carried**. Thus, the operator's willingness to cover the entire planned service is paid for, not efficiency in terms of filling vehicles or increasing ridership.

4.3. ColBus service in the Bolognese Apennines

ColBus services activated in the Bolognese Apennines represented an **on-demand public transportation** network **in the suburban** area, developed by SRM to serve suburban areas with discontinuous demand

The service was implemented in a territorial context classified as an "*Inland Area*" under the National Strategy for Inland Areas (SNAI) and Emilia-Romagna Regional Executive Resolution No. 512/2022, which confirmed and updated the perimeter for the 2021-2027 programming cycle.

Operational configuration of the service

ColBus service in the Bologna Apennines has been activated by SRM in two distinct seasonal configurations: *summer 2021* and *winter 2021-2022*, as a reservation-based LPT service on suburban lines, with differentiated operational and contractual characteristics.

ColBus summer 2021

The summer configuration was mainly intended for tourist users, with operation on weekends and holidays, corresponding to the main mountain resorts and isolated hamlets in the Bolognese Apennines:

- the service, which was organized on **fixed-route lines that could be activated by reservation**, also allowed partial routes to be operated according to requests received;
- **reservations** had to be made at least one day in advance, allowing the operator to plan the exercise consciously and adjust its organization according to actual demand.

the purpose was to guarantee the connection between marginal areas and the rail network, ensuring access to primary LPT hubs on days when ordinary supply was most reduced.

ColBus winter 2021-2022

During the winter period, the ColBus service was activated in two distinct operational configurations.

- **route 965**, operating **weekends and holidays**, was aimed at occasional non-commuter users heading to mountain and ski resorts. The service was based on **flexible routes** with no fixed schedules, articulated **over a network of widespread stops**. **Reservations** had to be made **by the previous day**, allowing the operator to plan the operation based on actual demand collected;
- **route 966**, on the other hand, operated on **weekdays** on **fixed routes and stops**. The service also provided the possibility of booking partial routes and was accessible with a **minimum of two hours notice of** the desired time. This configuration was designed to provide local mobility in low-demand areas where there was no regular line supply.

Remuneration model

The contract stipulated, for both seasonal configurations, a **maximum fee** defined over the entire period of validity. **The actual amount** recognized **varied daily**, **according to a formula** that distinguished between days with at least one activated ride and days with no reservations. In these two cases, a contractually predefined "*full share*" or "*reduced share*," respectively, was recognized. **Revenues** from ticketing were retained by the concessionaire and **did not contribute to the calculation of the** contractual **fee**.

ColBus summer 2021

The fee was **calculated daily**, depending on service activation:

- **€/day** for each vehicle used in at least one ride (activated vehicle);
- **€/day**, lesser value, for each vehicle prepared but not activated (stand-by vehicle).

ColBus winter 2021-2022

The **maximum consideration**, with two separate remuneration models for the two activated lines.

- **Line 965**, active weekends and holidays, the system adopted replicated the summer logic:
  - **€/day** per activated medium;
  - **€/day**, lesser value, for each means prepared and not activated.
- **Line 966**, which operates on weekdays, the contract provided for a **more articulated structure**, consisting of:
  - **hourly fee** €/h for each hour of scheduled availability;
  - **variable kilometer fee** €/km for each kilometer driven with at least one passenger on board;
  - **up to** a **maximum daily fee** per vehicle€$_{max*veicolo}$ /day.

The number of trips was limited to consider the maximum number of permissible driving hours for a driver. Through this last scheme, **a criterion of selectivity** was introduced **in the variable remuneration**, as the **mileage was valued only if it was done with the presence of users on board**.

Considerations

The two contracts include **specific operational conditions** for reporting and recognition of consideration:

- **in both contract seasons, remuneration was contingent on daily reporting according to a formula** that distinguished between days with at least one activated ride and days with no reservations;

- limited to **line 966** (ColBus winter 2021-2022), a selective clause was introduced that tied the **recognition of the mileage fee to the actual presence of users on board**: mileage was recognized only if it was done with at least one passenger, while mileage done without users did not activate this surplus mileage fee.

Overall, the Apennine ColBus adopted a **hybrid remuneration model**, which combined **fixed items** (daily and hourly availability) and **variable items** (activation, kilometers traveled with users), according to a logic that integrated **delivery incentives** and **partial transfer of operational risk**. In both periods, compensation was tied to a contractual ceiling, and the calculation logic introduced an initial form of user-based remuneration. The model:

- recognized operational readiness even in the absence of demand;
- rewarded effective activation and the presence of passengers;
- shared some of the demand-related business risk with the operator.

4.4. Comparison and general considerations

The analysis of the service contracts applied to DRTs in the Bologna area shows a diversification of remuneration models, defined according to the operating context, activation mode and the degree of economic risk attributed to the operator. The comparison is articulated along two lines:

- the operational **pattern of** operation, between fixed reservation lines and flexible area-based services;
- the **structure of the fee**, with fixed or variable components, dependent on tariff revenues.

Table 4-1 below summarizes the main characteristics of the services examined above:

	Col☎BUS Borgo Panigale	ProntoBus Pianura	Apennine ColBus Summer 2021	Apennine ColBus Winter 2021-2022
Operating scheme	Variable route between fixed stops divided into two groups; rides occur between different groups of stops	Fixed reservation lines and ordinary fixed schedule lines	Reservation-based suburban lines, operating on weekends and holidays, on a fixed route with the possibility of partial routes	Line 965 (weekends and holidays): flexible routes on network of widespread stops Line 966 (weekdays): fixed route with possibility of partial routes
Form of contract	Fixed annual availability fee + variable fee linked to ticketing revenue related to booked trips	Full compensation based on actual mileage disbursed	Maximum fee over the entire period, with full or reduced fee based on daily activation	Maximum fee over the entire period, with: Line 965: same summer pattern Line 966: hourly rate, mileage rate (with passengers only), daily maximum per vehicle
Method of reservation	Reservation required, with free access allowed if compatible with availability and route	Reservation required for dedicated lines	Reservation at least one day in advance	Line 965: by the previous day Line 966: at least 2 hours before the desired time
Method of calculating the fee	Fixed fee for operational availability + variable fee calculated on revenue from tickets sold for booked trips, subject to a ceiling	Proportional to the mileage performed, relative to a maximum threshold	Fee €/day per activated vehicle + reduced fee per standby vehicle	Line 965: as summer Line 966: €/h fee per availability + €/km with at least one passenger on board, up to a maximum €/day per vehicle
Revenue Management	Retained by the contractor. Only revenues from booked trips contribute to the variable fee; those from access without booking remain with the operator but are not contractually valued	Withheld by the contractor, do not contribute to the calculation of the fee	Withheld by the contractor, do not affect the calculation of the fee	Withheld by the contractor, do not affect the calculation of the fee

	Col☎BUS Borgo Panigale	ProntoBus Pianura	Apennine ColBus Summer 2021	Apennine ColBus Winter 2021-2022
Incentives for the operator	The operator is incentivized to maximize ticketing on booked trips; Ancillary revenues generated from unbooked accesses remain with the operator	The fee is related to the activation of the requested rides, not to the efficiency in terms of filling	Daily service activation incentive to maximize days with active service	Line 965: as summer Line 966: operational efficiency incentive, with mileage remuneration recognized only when there are passengers
Risk distribution	The operator assumes part of the economic risk; variable fee depends on ticketing revenue	Partial sharing: guaranteed a minimum threshold to cover fixed costs, fee increases according to actual mileage	Partial sharing: a share is provided even in the absence of activations	Line 965: as summer Line 966: risk related to the actual presence of users

Table 4-1 Comparison of DRT services carried out in the Bologna area.

Comparative analysis of contracts shows a diversification of remuneration models, with varying degrees of tariff risk transfer to the operator. The choice of model appears to be closely related to the type of service, territorial context and level of demand predictability.

In addition to economic aspects, a significant difference emerges in terms of **operational flexibility**, understood as the ability of the service to adapt dynamically to actual demand. Services configured with variable routes, flexible booking, and free access (as in the case of Col☎BUS Borgo Panigale or ColBus Summer Line 965) offer greater adaptability, but require an evolved management system and a more articulated contract structure. In contrast, services structured on predefined routes and stops (such as ProntoBus in Pianura and winter ColBus and summer Line 966) allow for more stable contractual management and simplified determination of the fee.

Hybrid contract models therefore offer tools to **empower the operator**, **incentivize efficiency** and **optimize the use of public resources**, but require a careful balance between **service flexibility**, **economic sustainability** and **regulatory quality**.

5. SWOT analysis of remuneration models for DRT services

This section analyzes the remuneration models applied in Demand Responsive Transport services, with reference to both the equivalent distance system (*Peq*) defined by DGR Lombardy X/4927/2016 and the operational experiences in the Bologna basin (Borgo Panigale, ProntoBus, ColBus Appennino). The analysis also includes proposals for methodological evolution, aimed at introducing corrective elements and quality indicators.

Each model is first summarized in its remuneration and management parameters (Table 5-1) and then evaluated according to a SWOT matrix (Table 5-2), with the aim of highlighting:

- The consistency between fee structure and service delivery mode;
- The balance between operational flexibility, economic risk and efficiency incentive;
- The potential for adaptation to weak demand contexts.

	Remuneration model	Elements of operation and management
***Peq* (Equivalent Mileage)**	*Peq* = service hours × average speed × correction coefficient (c); *Peq* = Pprog for fixed routes	- Operation pattern: fixed to fully flexible; - tools: variables (call centers, platforms, or both); - reservation: off-line or combined; - Driver: available on the full schedule; - Revenues: retained, but not always valued; - goal: integration into the LPT and territorial presidium
***Peq* evolutions**	*Peq* with adaptive coefficients (*c*), quality bonus (*a*), contextual costs	- exercise model: consistent with *Peq*, but with adjustments; - Tools: digital platforms, KPIs, tracking; - reservation: digital and combined; driver: available; - Revenues: possibly valued based on performance; - goal: efficiency, quality, equity
Col☎BUS Borgo Panigale	Fixed annual fee + variable fee linked to the income coming from booked trips	- Exercise model: variable route between stops of two groups; - tools: call center; - reservation: mandatory + conditional free access; - driver: available; - revenue: withheld; - goal: adduction to urban carrier network
ProntoBus	Proportionate share of mileage traveled, with guaranteed minimum threshold	- Operation model: fixed lines and reservation lines; - Tools: call center, centralized management; - reservation: mandatory for dedicated lines; - Driver: available throughout the time slot; - Revenues: withheld, not valued; - goal: relationship mobility in low-density areas
Apennine ColBus Summer 2021	Fixed daily fee per activated vehicle + reduced fee per standby vehicle	- Operation model: fixed routes with the possibility of partial routes; - Tools: offline booking in advance; - Reservation: at least 1 day in advance; - driver: available; - Revenues: retained, not valued in the consideration; - goal: tourism mobility in mountain areas

	Remuneration model	Elements of operation and management
Apennine ColBus Winter 2021-2022	Line 965: as a summer model; Line 966: hourly rate + mileage rate with passengers only + daily cap	- Operation model: 965 flexible; 966 fixed route with possibility of partial routes; - Tools: mixed reservation, variable advance; - reservation: 965 within day before, 966 min. 2h before; - driver: available; - revenue: withheld, but not valued in the calculation; - goal: minimum mobility in inland areas

Table 5-1 Summary of remuneration model and elements of operation and management

	Strengths	Criticality	Opportunities	Threats
***Peq* (Equivalent Mileage)**	- Standardization of criteria in service contracts; - Compatibility with existing TPL models; - Recognition of availability as a basis for calculation	- Correction coefficient not calibrated to real operating conditions; - Equalization with TPL for fixed routes does not value flexibility	- Expansion of services included in TPL service contracts; - simplification for awarding entities	- Mismatch between activity performed and remuneration; - Risk of underfunding in contexts of weak demand
***Peq* evolutions**	- Greater proportionality between consideration and operational effort; - Opportunity to reward efficiency and service quality	- Increased contractual complexity; - need for structured monitoring systems	- Customization according to context and service profile; - Introduction of KPIs as a regulatory lever	- difficulty in defining objective and verifiable parameters; - possible interpretive conflict between operator and foster caregiver
Col☎BUS Borgo Panigale	- Ticket sales incentive; - Operator empowerment; - flexible demand management	- Income from non-reservation accesses not contractually valued; - Variable quota subject to ceiling	- Enhancement of operational efficiency	- Commercial risk partially borne by the operator; - uncertainty about the volume of demand
ProntoBus	- Simplicity of fee calculation; - guarantee of minimum coverage of fixed costs	- Poor incentive for management efficiency; - Share recognized unrelated to level of utilization	- Integration into the main TPL contract; - guarantee of garrison in smaller centers	- Failure to enhance the demand served; - low contractual flexibility
Apennine ColBus Summer 2021	- remuneration of availability; - service activation incentive	- Absence of correlation between demand volume and consideration; - Stiffness of the model in case of unexpected demand	- Applicability to seasonal or tourist services; - simplicity in accounting management	- Risk of inefficiency in case of low demand; - mismatch between utilization and compensation
Apennine ColBus Winter 2021-2022	- Selective remuneration on the actual presence of passengers; - combination of availability and actual activation	- Complexity in reporting; - Risk of unrecognized rides in the absence of passengers	- Possible extension to fragile contexts with low demand; - Enhancement of actual utilization	- Increased operator exposure to the risk of empty rides; - Increased administrative burden on the commissioning entity

Table 5-2 SWOT analysis of remuneration models for the DRT.

6. Qualitative cost estimation by type of service

The objective of this chapter is to provide a **structured reading and estimation of individual elements of operating costs** in public transport services (detailed in chapter §0), distinguishing between traditional LPT and DRT services.

The proposed approach is **qualitative:** no numerical quantification is proposed, but a **comparative estimation of the relative weight of** the main **macro-families of costs**, divided between **fixed** and **variable**, in order to:

- highlight **the structural differences** to understand **which items affect** the economic model of the two types of services the **most**;
- support the construction of **differentiated remuneration models** consistent with the operational characteristics of DRT services.

6.1. Qualitative cost weight in standard TPL services

In traditional local public transport, service is planned with routes, schedules and frequencies established at the planning stage determining a **cost structure** mainly oriented on **fixed components** and allowing **predictive and programmable** management of variable components, which are contained and relatively homogeneous over time.

Fixed costs

Fixed costs in standard LPT represent the **predominant part of the economic commitment**. They are related to the continuous availability of vehicles, personnel and infrastructure, regardless of actual demand or kilometers traveled. This is why their **incidence is high and difficult to compress**.

Macro-family	Cost item	Qualitative weight	Operational Notes
Staff	Drivers with fixed shifts	High	Attendance guaranteed by TPL collective bargaining agreement, pay not linked to rides made
	Coordinators/operational supervisors	Medium	Needed for continuous service monitoring
Vehicle fleet and maintenance	Leasing/amortization	High	Multi-year contractual costs independent of utilization
	Insurance/ownership tax	Medium-High	Fixed item for each registered vehicle, even if unused
	Storage / parking	Medium	Monthly/annual fees possibly shareable among multiple services
	Means of escort	Medium	Necessary to ensure continuity of service in case of failure
	Scheduled maintenance	Medium	Mandatory cyclical interventions required by manual or regulation
Technologies	TPL management systems and software	Low	Generally shared, with low recurrent costs and little influence
General expenses	Locations, logistics, administration	Medium-High	Centralized structure, stable garrison for management and reporting
	Marketing of travel tickets	Medium	Includes reseller vig or fee for MaaS platforms

Table 6-1 Fixed costs in standard LPT services

Variable costs

The variable components of standard LPT are, on the other hand, linked to the actual performance of the service (trips made, kilometers traveled), but within a planned framework that allows for **good predictability and control of expenses**:

Macro-family	Cost item	Qualitative weight	Operational Notes
Exercise and consumption	Mileage-related costs	Medium	Proportional to km; predictable through stable scheduling
	Hours of availability and/or driving	Null	Not applicable in TPL. Driver is already provided in fixed shifts (fixed cost)
	Overtime hours of the driving staff	Low	Limited to emergencies or disruptions; infrequent in regular operation
Information technology and systems	Costs over SaaS contract thresholds	Null	Rarely found in TPL; restrained and static use of digital technologies
	Consumer services (SMS, transactions, forms)	Null	Generally absent or marginal
Inefficiency and adaptations	Uncompleted rides (cancellations/absences)	Null	Not applicable: service guaranteed regardless of the users present
	Long breaks between rides	Null	Absent due to fixed scheduling and defined frequencies

Table 6-2 Variable costs in standard LPT services

6.2. Qualitative weight of costs in DRT services

The operational configuration of DRTs results in an **articulated cost structure**, characterized by the coexistence ***of fixed components***, related to system availability, and ***variable costs*** influenced by **fluctuating external factors**, such as the distribution of demand and the actual activation of rides.

The weight of individual items may change depending on the type of service and spatial context, **but some components are recurring and outline a specific economic profile** that distinguishes DRT from standard LPT services.

Fixed costs

Fixed costs arise mainly from the **need to ensure service availability**, even in the absence of active demand. This availability involves structural burdens on means, personnel, technology and logistics:

Macro-family	Cost item	Qualitative weight	Operational Notes
Staff	Drivers assigned to the service	Medium-High	Mandatory contractual availability (CCNL TPL), independent of the trips made. In flexible models, they can operate multiple services (e.g., NCC, Taxi), but must guarantee a minimum availability that needs compensation
	Operational coordinators/local contacts	Medium	Stable figure, also useful in flexible models without continuous centralized supervision
	Operations center / call center personnel	Medium-High	Guaranteed presence to cover interaction with non-digitized or assisted users. Constant in active time slots, modulable according to the digitization of the service
Vehicle fleet and maintenance	Leasing/amortization	High	Contract on annual or multi-year basis, independent of use. Number of vehicles proportionate to hourly/geographic coverage

Macro-family	Cost item	Qualitative weight	Operational Notes
	Insurance / tax disc	Medium-High	Fixed costs per registered vehicle, higher for special vehicles (e.g., 4x4, accessible)
	Storage / parking	Medium	Constant fee, often on a monthly basis. Possibly shareable with other services
	Means of escort	Medium	Mandatory to ensure continuity in case of failure. They affect even if unused
	Scheduled maintenance	Medium	Cyclic servicing independent of mileage, mandatory by regulation and warranty
Digital technologies and platforms	Software fees, apps, management tools	High	SaaS contract or annual license, not dependent on rides made. Includes central-driver communication
	Path recalculation algorithms	Medium-High	Central function in free-flow DRTs, impacting the software fee
Overhead and logistics	Operating locations, utilities, administration	Medium	Fixed structure to be kept active regardless of demand level. Allocable pro-rata if over multiple services
	Marketing of travel tickets	Medium	Includes reseller vig or fee for MaaS platforms
	Communication, customer care, information	Medium	Presence of user information materials and channels. Includes institutional communication and support services

Table 6-3 Fixed costs in DRT services

Variable costs

They depend on the **actual level of service provided**, which can vary significantly over time and space. In more flexible models, the **variability of routes** and the dispersion of mobility demand also have an impact. This category includes items proportional to the activity performed, such as fuel, materials subject to wear and tear, and driving hours, but also components related to user interaction or operational inefficiencies. These conditions reduce the possibility of an estimate and increase the operator's exposure to economic risk related to demand instability:

Macro-family	Cost item	Qualitative weight	Operational Notes
Exercise and consumption	Mileage-related costs	High	They include fuel, wear materials, and maintenance proportional to use. The level of activity is not programmable a priori, but depends on actual demand, with variations due to irregular mileage and mileage dispersion
	Hours of availability and/or driving	Medium	In weak-demand models, they may activate only when reservations are made; variable component especially in ultra-flexible services
	Overtime hours of the driving staff	Medium	Triggered in case of unplanned peaks, congestion, or operational misalignments
Information technology and systems	Costs over SaaS contract thresholds	Medium	Incremental costs associated with exceeding contractual thresholds on number of vehicles, requests, or hourly/geographic extent
	Consumer services (SMS, transactions, forms)	Medium	Activated only when there are high volumes of user interaction, typical of tourism settings or with seasonal services
Inefficiency and adaptations	Uncompleted rides (cancellations/absences)	Medium	Rides often recognized in the contract anyway. They involve non-recoverable out-of-pocket costs (empty miles, time, missed reallocation)

Table 6-4 Fixed costs in DRT services

6.3. Comparison and general considerations

With the same cost items, TPL and DRT have different economic structures in terms of flexibility, predictability, and sustainability.

The following is a qualitative comparison articulated between **fixed** and **variable costs**, highlighting **structural differences**, **rigidities,** and **possible levers of modulation** for each, consistent with the macro-families and operational items identified.

Fixed costs

Macro-family	Cost item	TPL weight	DRT weight	Comparative Notes
Staff	Drivers	High	Medium-High	- Fixed voice in both services; - In DRTs, even in the most flexible models, a minimum guaranteed provision is required unless outsourced. In some cases it can be supplemented by already active NCCs or cabs
	Coordinators/referents	Medium	Medium	- Needed in both services; - In the DRT, territorial presence may be lighter or partial, depending on the operational organization
	Operations center / call center	Absent	Medium-High	- Item absent in standard TPL; - In DRTs, it is central to reservation management, particularly for non-digital users
Vehicle fleet and maintenance	Leasing/amortization	High	High	- Fixed costs in both services; - In DRTs, fleet size is often proportional to coverage area rather than ride volume
	Insurance/ownership tax	Medium-High	Medium-High	- Constant voice in the two services; - Costs associated with the number of vehicles available regardless of their actual use
	Storage / parking	Medium	Medium	- Fees present in both services; - In the DRT they can be shared or decentralized depending on the logistic configuration
	Means of escort	Medium	Medium	- Needed in both services; - In DRTs they may be required in extended or fragmented contexts to ensure continuity in case of simultaneous activations or failures
	Scheduled maintenance	Medium	Medium	- Mandatory interventions in both services; - Costs independent of actual mileage as defined by regulations, technical manuals
Digital technologies and platforms	Management systems/digital platforms	Low	High	- Marginal item in standard TPL; - In DRTs, it is an indispensable structural component for service operation
	Path recalculation algorithms	Absent	Medium-High	- Not present in standard TPL; - In DRTs with free flow, they are critical for dynamic path generation
Overhead and logistics	Locations, logistics, administration	Medium-High	Medium	- More established structure in standard TPL, with offices and functions often centralized; - In DRTs, requirements may be lower, but remain necessary to ensure administrative and support management
	Marketing of travel tickets	Medium	Medium	- Present in both models; includes reseller vig or fee for MaaS platforms dedicated to sales

Table 6-5 Fixed cost comparison: LPT vs. DRT

- in **standard LPT**, the **fixed cost** structure is by its very nature rigid: the main items are related to service continuity and are **difficult to compress**;
- in the **DRT**, although there is less regularity in delivery, the need to still ensure operational availability means that a **stable share of fixed costs** is maintained, **even in the absence of activated rides.**

Some formally fixed items in the DRT may have room for operational flexibility, depending on the management model adopted. This is the case with driver personnel, whose allocation may be reduced in fully outsourced models or integrated with resources already operating in the territory (such as NCCs or cabs), while still ensuring a minimum level of availability to be compensated. The operations center can also be partially automated, or downsized, in the presence of more advanced digital interaction. Finally, logistics and administrative functions can be organized **in a lighter, decentralized or shared form**, while still maintaining the activities essential to service management.

Variable costs

Macro-family	Cost item	TPL weight	DRT weight	Comparative Notes
Exercise and consumption	Mileage-related costs	Medium	High	- In standard LPT, consumption is proportional and planned; - In the DRT, it depends on the service actually activated, with irregular rides and greater dispersion
	Hours of availability and/or driving	Absent	Medium	- Not present in standard TPL; - In the DRT they may be a variable cost in flexible models, activated only on request
	Overtime hours of the driving staff	Low	Medium	- In standard TPL they are limited; - In the DRT they may increase due to the uneven distribution of mobility demand over time
Information technology and systems	Costs over SaaS contract thresholds	Null	Medium	- Absent in standard TPL; - Present in the DRT when contract thresholds are exceeded (e.g., vehicles connected, requests handled)
	Consumer services (SMS, transactions, forms)	Null	Medium	- Incremental costs in DRT related to digital user interaction; more relevant in tourism or high seasonality settings
Inefficiency and adaptations	Uncompleted rides (cancellations/absences)	Null	Medium	- In standard LPT, operation is guaranteed regardless of the users present; - In the DRT they generate uncompensated out-of-pocket costs, often partially recognized by contract

Table 6-6 Variable cost comparison: standard TPL vs. DRT

In **standard LPT, variable costs** are generally programmable, since they depend on a volume of service established at the planning stage and **tend to be constant over time**. The regularity of trips and predictability of demand allow for controlled management of key variable items, such as costs related to miles traveled, wear and tear materials, and corrective maintenance.

In **DRT**, the same components are **less predictable and more sensitive to operational conditions**. Discontinuous demand distribution, route variability, mileage dispersion, and the frequent presence of operational inefficiencies - such as uncompleted rides or long breaks between rides - make ex ante planning more complex and increase exposure to economic risk. Added to this are variable costs associated with consumable technologies, such as activating extra modules, sending SMS or incremental use of platforms beyond contractual thresholds.

7. Economic and management strategies for sustainability of DRT services.

DRT services involve a high exposure to operational risk and management variability that necessitates careful economic planning. This chapter proposes a concise representation of the economic sustainability of DRT, declined according to the **four main operational configurations**, each discussed in a self-contained section:

- **Service 1** - Basic route with fixed stops
- **Service 2** - Basic route with detours and fixed stops
- **Service 3** - Free routes between a predefined set of points
- **Service 4** - Free routes between any set of points

For each service, the possible **strategies that can be activated by the contracting station** with the aim of ensuring the minimum conditions for service delivery and efficient use of public resources are framed, as well as the **management strategies that can be implemented by the operator**, aimed at containing costs, ensuring business continuity and accessing the forms of remuneration provided by the contract.

7.1. Service 1 - Basic route with fixed stops

	Strategy - Contracting Station	Strategy - Operator	Possible tariff arrangements
Fixed costs	- Provide an availability recognition mechanism (e.g., fixed daily or monthly fee), with the aim of ensuring business continuity even in the absence of demand and ensuring a stable economic base for the operator; - Establish multi-year contracts to encourage sustainable investment in vehicles and infrastructure; - Evaluate the adoption of a single or shared digital platform for reservation management, integrated with existing TPL systems; - Prefer interoperable solutions to minimize fixed costs - Recognize an annual flat administrative fee in the PEF, with the aim of covering management expenses independent of production and limiting improper discharges to variable costs	- Integrate vehicles and personnel across multiple compatible services (e.g., school, shuttles) to maximize utilization rates and amortize fixed costs; - Schedule cyclic maintenance work on non-service days to avoid costly downtime - Merging management functions among multiple services and contiguous territories to reduce overhead costs and rationalize the organization	- Apply integrated tariff with urban LPT as a service in adduction to the main network; - During soft bands, provide low surcharge to compensate for lower saturation
Variable costs	- Recognize in the contract only the miles actually traveled with users on board, with the goal of aligning remuneration with production; - Establish a cap on remunerable daily mileage to avoid inefficient behavior	- Optimize ride and schedule scheduling based on historical usage data, reducing empty rides and increasing hourly efficiency	- Maintain uniform base fare for major routes; - Provide slightly increased fare for secondary or low demand routes, especially in non-core time slots

Table 7-1 Economic and management strategy for DRT service with fixed route and predetermined stops

7.2. Service 2 - Basic route with detours and fixed stops

	Strategy - Contracting Station	Strategy - Operator	Tariff adjustments
Fixed costs	- Provide a fixed fee for daily operational availability of the service, even in the absence of activated rides, to ensure coverage on all points of the network; - Provide for co-financing among multiple entities in the case of a distributed network; - Integrate into the contract the availability of a digital platform for booking and routing, choosing between SaaS or centrally developed and managed system - Recognize in the contract a flat fee for administrative management, calculated according to network size and operational complexity; - Provide for annual update based on change in points served	- Organize the availability of assets and personnel over planned time and geographic windows to avoid operational dispersion; - Use the indicated platform to aggregate requests and optimize routes; - Integrate cyclical maintenance during non-operational periods - Merge management functions with other similar services to contain overhead costs; - Automate booking and support functions with shared digital tools	- Base rate proportionate to the average distance between network points; - Apply fixed surcharge for requests involving major deviations from the most direct route - In general, good organization reduces overhead costs and avoids repercussions on the rate charged to users
Variable costs	- Calculate the actual miles traveled with users on board as the basis of the variable consideration; - Monitor empty miles and average stroke saturation using digital KPIs; - Define in the contract minimum standards for routing optimization and aggregation software required	- Use dynamic dispatching system to reduce empty miles and improve load factor of vehicles; - Optimize shifts and schedules based on data collected in operation	- Rate proportional to actual miles; - Introduce increased tariff in case of single, non-aggregable request, with ex ante information to the user

Table 7-2 Economic and management strategy for DRT service with fixed route and detour on demand

7.3. Service 3 - Free routes between a predefined set of points

	Strategy - Contracting Station	Strategy - Operator	Tariff adjustments
Fixed costs	- Provide a fixed fee to ensure the daily availability of the service even when there are no rides; - Integrate the availability of a digital platform for booking and routing (SaaS or central system) into the contract; - Provide for co-financing among multiple entities in the case of a distributed network; - Include costs for planned cyclical preventive maintenance - Recognize a flat fee for administrative management, updated annually based on points served and operational complexity	- Arrange the availability of vehicles and personnel on predetermined time windows and areas to avoid dispersion; - Use the digital platform to aggregate requests and optimize routes; - Schedule maintenance work during periods without service - Merging management with other services to contain overhead costs; - Automate operational and administrative functions with shared tools	- Basic rate proportionate to the average distance between network points; - Apply fixed surcharge for requests involving major deviations from the most direct route - In general, an efficient organization avoids passing on overhead costs to the user rate
Direct operating costs (variable)	- Calculate the miles traveled with users on board as the basis of the variable consideration; - Monitor empty km and saturation through KPIs; - Set minimum standards for the efficiency of optimization software	- Use dispatching systems to reduce empty miles and improve average load per ride; - Adapt shifts and rotations based on collected data	- Rate proportional to km; - Introduce increased rate for non-aggregate single requests, communicated to the user at the booking stage

Table 7-3 Economic and management strategy for DRT service with free routes between defined points

7.4. Service 4 - Free routes between any set of points

	Strategy - Contracting Station	Strategy - Operator	Tariff adjustments
Fixed costs	- Provide a fixed fee to ensure service availability even when there is no demand; - Integrate a high-capacity digital point-to-point management platform into the contract, choosing between SaaS or centralized development; - Provide inter-municipal co-financing for services in large area; - Include coverage of cyclical preventive maintenance; Evaluate mixed models that include participation of licensed operators (NCC, cabs) on call - Recognize a flat fee for service management, related to the territorial extent and degree of customization required; - Fostering administrative aggregation among awarding entities; - Provide for the possibility of centralized management by inter-municipal areas	- Use non-fixed means and personnel that can be activated only on demand, including through agreements with external operators, to reduce costs associated with the continuous availability of own resources; - Use the planned digital platform to aggregate requests and optimize routing; - Schedule cyclic maintenance during downtime; - Avoid exclusive use of dedicated means or personnel unless necessary - Merging administrative functions among multiple areas served; - Automate reservations, request management, and billing through single platform; - Use centralized or shared back-office	- Apply point-to-point tariff proportional to the distance traveled; - Introduce dedicated fare for single requests or non-aggregate rides, informing the user at the booking stage; - Charging a surcharge or limiting service delivery during night hours or outlying areas unless predefined minimum conditions are met (e.g., multiple reservations, minimum advance payment, significant distance) - Digital and inter-municipal management can reduce overhead costs and contain the impact on rates charged to users
Variable costs	- Monitoring of empty mileage and aggregation rate using digital KPIs; - Inclusion of minimum routing efficiency indicators in the contract (e.g., average users per ride)	- Use intelligent real-time dispatching systems to optimize load distribution and reduce unproductive miles; - Adapting shifts and vehicles to the most in-demand areas and time slots, including with "dynamic on-demand" logic	- Rate proportional to the distance traveled; - Apply increased fare in case of individual rides or those with low aggregation rate; - Provide a threshold fare structure (band/suburban/suburban) if consistent with the area served

Table 7.4Economic and management strategy for DRT service with free point-to-point routes

8. Integration of DRT services into the service contract

The inclusion of DRT services in service contracts requires the analysis of certain technical and managerial elements that make their integration into the LPT system possible. Compared to regular scheduled services, in fact, DRTs present greater operational complexity requiring more complex evaluation activities. This chapter provides some aspects to be properly taken into account to reduce these burdens.

8.1. Priority elements to consider

Coordination between DRT and TPL services.

Effective integration between DRT and existing TPL network reduces inefficiencies and maximizes benefits for users and the awarding agency:

Principle of integration	Description
Avoid overlap with fixed services	- Integrated DRT planning to cover areas and times not served by traditional LPT; - Avoid duplication of fixed line routes; - Reduce wasted resources and unnecessary costs
Ensuring tariff integration	- Provide for integrated travel tickets between DRT and TPL; - Offer concessions to LPT subscribers
Unify communication and booking channels	- Integrating the DRT into the digital platforms of the LPT; - Allow combined scheduling and booking between fixed lines and DRT; - Avoid the use of separate, confusing applications; - Ensure consistency in information (schedules, fares, travel solutions); - Reduce operating costs and simplify staff activities
Integrating DRT into path construction and user experience	- Include DRT rides in route calculation systems; - Offer truly intermodal travel solutions; - Ensure continuity among services in travel planning; - Strengthen the role of the DRT as an adduction service to the main grid

Table 8-1 Coordination between DRT services and LPT network

Compliance with personnel contract regulations

The organization of the DRT service must ensure **full compliance with labor regulations** applicable to the personnel employed, especially drivers. Limits on driving hours, rest periods, and shift duration are established by European standards[2] , national legislation[3] , and the CCNL Autoferrotranvieri[4] . The service contract must set operating conditions and constraints compatible with these provisions, to avoid excessively fragmented or unpredictable shifts.

Service monitoring and technology KPIs

DRT monitoring must be continuous and based on technologies already adopted in LPT. Tools such as GPS/AVM, electronic validation, and digital reservation records must be used for specific purposes and linked to measurable performance indicators. Any technology implemented must produce data useful for

[2] Regulation (EC) 561/2006, as amended, Regulation (EU) 2024/1258

[3] Law 138/1558 and D. Lgs. 66/2003, as well as specific provisions for the local public transport sector

[4] National Collective Bargaining Agreement for Motor Carriers 2024-2026

the contracted KPI system. Indeed, the digital solutions available today, including platforms for DRT management and integrated ticketing systems, are an essential tool for service control:

Monitoring tool	Operational purpose	Associated KPIs (examples)
Vehicle Localization (GPS/AVM)	Track DRT vehicles in real time, verify adherence to schedules and routes, track mileage	- % on-time rides - Average delay (min) - Miles traveled out of service
Electronic validation of tickts	Investigate passenger accesses and ticketing, integrating them into the TPL fare system	- Total passengers by time slot - Average occupancy rate - DRT introductions per km (€/vett-km)
Digital reservation register	Record travel requests, advance booking, cancellations, and non-fulfillments. Enable analysis of mobility demand and performance	- Service rate (requests fulfilled/total) - Average time confirmation and pick-up - Average passengers per ride

Table 8-2 Monitoring technologies and associated KPIs

Data collected through these tools enable the contracting entity to verify compliance with agreed quality and productivity standards. For example, joint analysis of AVM data allows the identification of operational inefficiencies while validation data can support the monitoring of the fill ratio. Each technology should contribute to the construction of KPIs that are clear, measurable and linked, if provided, to incentive or penalty mechanisms, in line with what is already applied for scheduled services.

In **territorial contexts with low tel.co. network coverage**, a service model may be adopted that provides for compulsory booking by the previous day, allowing for certain planning of the exercise. In these cases, the contract may provide for a **predetermined daily fee** on actual service activation, without distinguishing between fixed and variable costs, as in the examined case of Colbus in the Bolognese Apennines.

Optimization and reduction of fixed costs

Fixed costs are critical to DRT economics and should be managed from the start:

- integration of the service into the LPT can facilitate the containment of these items through the **shared use of existing resources**, optimization of the vehicle fleet, and flexible management of support staff;
- special attention should be paid to **booking platforms**, which are a major fixed cost item. The choice between SaaS (*Software as a Service*) solutions and internally developed platforms significantly affects overall costs: it is important to evaluate the most efficient option in terms of initial investment, maintenance costs, and scalability, while also considering the possibility of sharing these platforms with other TPL services to maximize economic efficiency.

Fixed cost item	Optimization strategies
Dedicated vehicle fleet (purchase/lease)	- Sizing the fleet according to demand, avoiding underutilized vehicles; - Give preference to small or low operating cost vehicles that are compatible with the expected loads; - Also use DRT vehicles on regular low-frequency rides, during times when they are not booked, to improve their economic performance
DRT booking and management platform	- Evaluate SaaS solutions versus in-house development based on cost and scalability; - Integrate the platform with the existing TPL system to avoid duplication; - Share the platform among multiple agencies/operators if the service serves multiple areas; - Evaluate interoperable and shared inter-municipal or regional solutions to standardize service and reduce costs
Infrastructure and support staff	- Use existing facilities (e.g., operations center, call center), avoiding duplication; - Train staff to manage both DRT and TPL, increasing operational flexibility; - Share fixed costs among multiple entities in the case of inter-municipal or supra-municipal services

Table 8-3 Main DRT fixed cost items and optimization strategies

Optimization and reduction of variable costs

The variable costs of DRT **depend directly on the volume of service delivered**. To contain the economic impact of the model, it is essential to intervene with organizational and technological solutions that improve operational efficiency without compromising effectiveness:

Variable cost item	Optimization strategies
Operation and consumption (mileage, vehicle wear and tear)	- Carefully plan areas and times of operation early in the service design phase to optimize demand coverage; - Optimize routes through routing (*dispatching*) software. These tools allow more efficient routes to be planned, reducing empty distances traveled and improving vehicle utilization; - Optimize preventive maintenance processes on actual vehicle usage. This approach reduces corrective interventions, helping to contain overall operating costs, reducing breakdowns and extending the useful life of components - Employ fuel-efficient or high-efficiency vehicles, consistent with the service required
Employment of personnel (driving hours)	- Adjust shifts according to actual demand, avoiding unnecessary deployments in low-demand slots; - Employ part-time or flexible shift staff, always in compliance with current regulations; - Allow staff to be deployed on other TPL services as well, optimizing the use of human resources

Table 8-4 Main DRT fixed cost items and optimization strategies

Financial and tariff sustainability

When defining the financing model for DRT service, it is also important to consider the tariff structure to be applied to users, as it represents a **major component of service revenues**. Indeed, the setting of tariffs affects the overall economic balance, affecting the share of financial coverage that can be generated directly through users and, consequently, the extent of any compensation to be paid to the operator.

The flexible and customizable nature of DRT may result in differential operating costs compared to scheduled LPT, making it appropriate to provide for tariffs that can be modulated according to the type of service provided. **It is appropriate for the service contract to provide clear and regulated tariff conditions** that distinguish between standard situations and services with greater individualization, maintaining objective and transparent criteria for the user and the awarding entity.

Service or user characteristics	Applicable tariff criterion
DRT in adduction to the main TPL network (up/down at stops on the main network)	- Integrated LPT fare (ordinary ticket or season ticket), since it is a complementary service to the main network.
Point-to-point DRT (custom origin and destination)	- Dedicated or additional rate, commensurate with the higher level of customization (e.g., mileage or fixed surcharge).
Users entitled to concessions (LPT subscribers, the disabled, the elderly, students)	- Reduced or symbolic fare, aligned with TPL facilities to ensure equity and accessibility.

Table 8.5 Tariff differentiation by service or user characteristics

8.2. Possible integration strategies in the service contract

As for how **DRT services can be integrated** within local public transport **service contracts**, some possible **strategies for incorporating DRT into the service contract** are outlined below

The integration of DRT services into local public transport service contracts can be implemented in different ways, chosen according to network design, contract structure and territorial coverage objectives. Two distinct approaches are noted in national contexts, corresponding to as many operational configuration models:

- **Direct inclusion of** the DRT in the service contract as an integral part of the minimum service;
- **Separate** contracting of DRT services through stand-alone contracts, external to the main LPT contract.

Each approach involves specific contractual choices, particularly about:

- DRT's contractual schedule, specifying the areas served, operating modes, and recognized service volumes;
- The method of determining and settling the fee;
- The articulation of the performance monitoring system;
- The application of any reward or penalty clauses.

8.2.1. Direct integration

The direct incorporation of DRT into the service contract takes the form of a mode in which DRT is recognized for all intents and purposes as an ordinary mode of operation of local public transport, subject to the same planning, entrustment and control criteria as for scheduled services. The service contract incorporates its specific characteristics, including it in the general network with functions of adduction, replacement or coverage of low demand areas, through consistent planning and unified reporting. In this scenario, the **DRT** is therefore not configured as an additional or experimental service, but **as a structural component of the network**.

Consistent with the provisions of the Transportation Regulatory Authority in Resolution No. 48/2017, the integration of DRT into the contract presupposes the existence of spatial planning that explicitly defines the treatment of areas of weak demand and their articulation within the local public transport system. Specifically, the planning:

- identifies **weak demand areas** based on objective and measurable criteria, such as population density, distribution of demand, and accessibility to essential services, consistent with potential demand parameters;
- identifies **the most appropriate mode of operation for each area**, including the adoption of DRT or other flexible solutions, taking into account observed demand and sustainable operating costs;
- allows the establishment of differentiated economic targets, with cost coverage thresholds compatible with the operating conditions of the areas concerned, subject to minimum service obligations;
- directs planning toward transportation solutions other than fixed-route scheduled services, where these are more likely to meet the expressed demand, according to a **public service** logic **built on the basis of actual user needs**.

Planning must therefore be supported by an **analysis of transportation demand** broken down by zone, time slot, and user profiling. The location of DRT service cannot be defined in the abstract or as an exclusive function of existing supply, but it requires a timely analysis of mobility needs not covered by the ordinary network. **In the presence of an integrated planning system** (*Basin Plan, PUMS, territorial operating plans*), **the inclusion of DRT in the contract can take place with a high degree of functional consistency, avoiding duplication, overlap or gray areas of responsibility**.

In the direct integration model, the DRT is explicitly described in the body of the service contract or in a technical annex, with elements defining its operational and management characteristics. In particular, the following must be specified:

- **The areas covered by the service**;
- **operational arrangements**, including reservation systems, hours of availability, type of vehicle used, and associated information infrastructure;
- **the recognized service volumes**, expressed in equivalent kilometers or other parameter compatible with the adopted cost model;
- **the expected fee**, which can be dedicated or integrated into the total fee recognized for the minimum service.

The DRT, where integrated, is subject to the same rules applied to other minimum services, including mechanisms for reporting, performance monitoring, penalty or reward system, as provided in the dedicated sections of the service contract.

8.2.2. Separate contracting

Another way of integrating DRT into the local public transport system is through **separate contracts**, through **contracts or conventions independent of the main service contract**. This strategy is adopted when DRT service is **marginal, experimental or punctual in nature**, and it is more effective to manage it with dedicated contractual instruments, while maintaining external coordination with the LPT operator.

In the separately entrusted model, DRT **is not included in the scope of the standard LPT service** and **is not regulated within the main operating contract**. The service operates as an **ancillary intervention**, often at the initiative of local authorities or the LPT governing authority, and is intended to **cover portions of the territory, time slots or users** not adequately served by the standard network. Positioning with respect to the system may vary according to scope:

- **complementary**, if integrated on the information or tariff plan;
- **residual**, if managed in total autonomy from the ordinary system.

The activation of services through separate contracting **does not necessarily presuppose a systemic framing in planning tools** (PUMS, Basin Plan, etc.), although such consistency is desirable. More often, such services arise from:

- specific local needs not covered by the general contract;
- external funding opportunities (e.g., European funds, regional measures);
- experiments promoted by municipalities or agencies in an autonomous form.

The temporary and circumscribed nature is a common feature of many separate contracts in which the duration is often **limited in time**, partly due to the availability of funding or the pilot nature of the intervention. In the absence of explicit renewals or later formalization in the general contract, such services remain **external interventions with limited validity**.

Fostering can be done through:

- **autonomous service contract**, with definition of fee, operating conditions, duration and minimum obligations;
- **temporary concession or regulated authorization**, in which the managing entity operates under defined conditions, but with wider organizational margins;
- **direct agreements between local government and third-party operators** (e.g., cooperatives, NCCs, collective cabs), with regulation of economic flows and responsibilities in a simplified manner.

In some cases, services may be operated by entities already active in the area, but outside the scope of the main contract. Contracting may include **minimum forms of integration** with the existing system (e.g., electronic ticketing, publication of schedules on institutional portals, shared reservation systems), without implying formal inclusion in the service contract.

Although not included in the service contract, **these procurements may provide for forms of technical coordination with the local public transport system**, such as using the same electronic ticketing platform, publishing hourly information on official entity channels, and adopting compatible digital tools for booking. These forms of coordination do not change the contractual nature of the service, which remains external to the main contract and does not fall under the definition of a minimum service.

8.2.3. Comparison and general considerations

The two strategies for integrating the DRT into public transport systems have differing configurations **from contractual, operational and institutional** perspectives**.** To facilitate the reading of the following Table 8-6, the elements of comparison are grouped into **four thematic areas**, reflecting the logical sequence of building and operating a DRT integration model:

1. *Institutional and contractual framing*: placement of the DRT in relation to the service contract and how it is legally formalized;
2. *Planning and economic regulation*: reference tools and criteria for determining consideration:
3. *Operational and time management*: service duration, entrusted parties and organizational configuration;
4. *control, coordination and digital tools*: monitoring systems, technical interoperability and degree of integration into the existing network.

Subject area	Parameter	Direct integration	Separate custody
Institutional and contractual framework	Contractual classification	Included in the main service contract as a minimum service component	Autonomous contract, out of the main CdS
	Contract formalization	In the body of the main contract or in technical annex with full validity	In separate contract or deed, with independent regulation and simplified structure
Economic planning and regulation	Technical formalization	Detailed in the contract documents and technical annexes	Regulated in separate acts, concessions or direct agreements
	Reference planning	Consistent with the basin plan and/or superordinate documents	Sometimes external to official planning, activated by local initiative
	Fee and how it is calculated	Included in total consideration or defined by separate item	Self-defined, on a mileage or flat-rate basis
Operational and time management	Duration of service	Stable for the entire duration of the contract	Temporary or tied to specific resources
	Service manager	Same operator holding the CoS	Internal or external parties (cooperatives, NCCs, other operators)
Control, coordination and digital tools	Monitoring and KPIs	Included in the contract control system	Variable, often unstructured or delegated to the local authority
	Technology/information integration	Full (ticketing, mobility info, reservation)	Possible but optional, does not imply inclusion in the CoS
	Placement in the network	Integral part of the ordinary network, programmed upstream	Ancillary service, complementary or parallel to the main network

Table 8-6 Comparative table - Strategies for integrating DRT into the service contract.

The strategies described respond to different operational and institutional needs:

- **direct integration** is indicated in contexts where the DRT is a stable and planned part of the network, with full contractual regulation and inclusion in the LPT service. It requires a sound planning framework and control tools already in place;
- **separate contracting** is an agile and adaptable solution, useful for punctual interventions, in marginal contexts or those not covered by the CoS. It is easier to activate, but less structured in terms of governance and long-term sustainability.

In summary, it is good that the choice among strategies should consider the **spatial configuration**, the **relevant institutional structure**, the **current planning**, and the **contractual capacity of the awarding**

entity, evaluating the balance between operational efficiency, service inclusiveness, and economic sustainability.

8.3. Performance indicators (KPIs) to be included in the contract of service

In the context of this paper, the inclusion of *performance indicators* (KPIs) in service contracts represents a **tool for defining measurable criteria for evaluating, monitoring and controlling service delivery.** KPIs assume particular relevance in DRT services as an operational mode that, due to inherent characteristics, **does not lend itself to the immediate application of traditional line standards**.

This section is therefore devoted to suggesting some possible **performance indicators** (KPIs) specific to DRT services by classifying them into four functional areas: **service quality, operational efficiency, economic sustainability and integration with the LPT.** For each area, **measurable metrics** and **criteria for contractual application** are proposed, with a comparison between **indicators provided by current regulations and KPIs proposed ad hoc for the DRT**, compared to the minimum set provided by ART Resolution No. 64/2024.

8.3.1. Service Quality KPIs

Quality indicators measure the **ability of the service to meet user needs**, both in subjective (perception) and objective (regularity, accessibility) terms. In dial-a-ride services, these KPIs assume an important role, as they allow the evaluation of the quality actually delivered in services that are not structured on fixed schedules or routes.

User satisfaction

This indicator is collected through periodic surveys, including sample surveys, which return a summary index (*Customer Satisfaction Index*) representative of the **judgment expressed by users**. The contract may provide a threshold value to be met on an annual basis, expressed as a percentage of satisfied users or as an average score on a defined scale. The most common areas of survey include service availability, ease of booking, punctuality, comfort on board, and quality of interaction with staff. The indicator allows assessment of perceived quality and, if well structured, can support decisions on targeted corrective action.

Service rate and reliability

The service rate expresses the **percentage of rides performed, compared to those booked**. This KPI is particularly relevant in the DRT, where each ride is activated upon individual request and failure to deliver can undermine confidence in the system.

$$\left(\frac{trip\ made}{trip\ booked}\right)\%$$

The contract may establish minimum reliability thresholds and provide for the exclusion of trips canceled due to external causes or lack of demand. The indicator makes it possible to monitor the **operational regularity of the service and its effective responsiveness to expressed demand**.

Accessibility

This indicator assesses **the extent to which the service is accessible** to all users, both in terms of physical accessibility (e.g., the presence of vehicles enabled to transport people with disabilities or reduced mobility - PRM) and in terms of digital accessibility. Measurement can be based on data such as the percentage of rides made with accessible vehicles, the percentage of reservations made via telephone (relevant for non-digitized users), and the share of requests processed via apps or online platforms. Inclusion of this KPI in the contract allows **the service to be aligned with the principles of universality, equity, and usability** expected for LPT.

8.3.2. Operational Efficiency KPIs

Operational efficiency indicators measure the **relationship between the resources deployed and the results achieved in terms of service production and utilization**. In the case of DRT, these KPIs make it possible to assess the adequacy of the adopted model with respect to actual demand, the balance between cost and utilization, and the ability of the service to operate in a timely and functional manner.

Load factor

Load factor expresses the **average vehicle load factor**, calculated as the **ratio of passengers carried to available seats**. In DRT services, where vehicle composition may vary (minibuses, M1 vehicles, etc.), the value can also be expressed in normalized form through the ratio of passenger-km to seat-km offered:

$$\frac{passenger\ km}{seat\ km\ offered}$$

This indicator allows monitoring the **adequacy of service sizing relative to the demand served** and can be disaggregated by area, time slot, or type of vehicle. Persistently low values indicate possible oversizing or misallocation of availability.

Productivity

Productivity measures the **intensity of service use**, i.e., the number of passengers carried in relation to kilometers traveled or hours of service provided.

$$\frac{passenger}{km} \quad \text{oppure} \quad \frac{passenger}{service\ time}$$

In the DRT, where the service is activated by reservation, this indicator makes it possible to **compare the efficiency of different** operating **schemes** (fixed, semi-dynamic, dynamic) **and to support possible recalibrations of the model**. Productivity can vary significantly depending on the spatial context and the reservation mode adopted.

Efficiency of service utilization

The indicator measures the **degree to which the service is used compared to the contracted availability**. It is defined as the ratio of hours of service provided to the total hours in which the service could have been active, according to the agreed operating plan or time window:

$$\left(\frac{actual\ hours\ of\ service}{total\ hours\ available}\right)\%$$

The indicator makes it possible to **highlight the unused time that still burdens fixed costs** and provides a useful benchmark for optimizing operational organization, assessing any over-availability of resources, and calibrating service delivery to actual demand.

Punctuality and regularity of operation, user waiting time

This indicator assesses **the ability of the service to meet the pickup time stated at the time of booking**. It can be expressed as an average wait in minutes or as the percentage of requests served within a predetermined time threshold (e.g., 15 or 20 minutes). An additional useful parameter may be the average delay per ride compared to the scheduled time.

In the service contract, punctuality can be declined depending on the service configuration (fixed points, time window, flexibility margin) and must be compatible with available tracking technologies. This KPI makes it possible to assess the actual quality of the user experience in the DRT.

Demand response capability

Measures the ratio of projected demand to actual demand served, and allows for **an assessment of consistency between planning and operational capacity**. The value can be estimated on an aggregate basis (e.g., basin or area served) or disaggregated (by time slot or user type). In a DRT system:

$$\left(\frac{requests\ fulfilled}{total\ requests\ received}\right)\%$$

The indicator is useful for identifying situations of overload, lack of resources or organizational inefficiencies. In experimentation, it can be associated with minimum acceptable thresholds, above which operational revisions are triggered.

8.3.3. Economic Sustainability KPIs

Indicators of economic sustainability make it possible to **assess the balance between the costs incurred in providing the service and the revenues generated, as well as the overall economic efficiency of the operating model**. In DRT services, economic measurement requires adaptation of traditional LPT parameters, depending on demand variability, service flexibility and the structure of the contract applied (net or gross cost).

Cost per passenger carried

Represents the ratio of **total operating cost to the number of passengers carried in each period**. It can be calculated gross or net of traffic revenues, depending on the contract configuration.

$$€_{passenger} = \frac{operating\ costs}{passengers\ carried}$$

This indicator makes it possible to **assess the overall efficiency of the service** and can also be used in experimentation to compare different operational solutions on a consistent basis.

Operating cost per km

Measures the **average operating cost per kilometer produced**, including the main expense items: fuel or energy, maintenance, personnel, vehicle depreciation, management and overhead.

$$€_{vehicle-km} = \frac{operating\ cost}{km\ traveled}$$

Alternatively, it can be calculated on a €/seat-km basis, which is useful in the case of variable capacity vehicles. **The definition of the parameter should be consistent with the cost structure in the contract** (e.g., in gross or net cost cases). This KPI finds application in integrated models where DRT is part of the minimum service.

The indicator is affected by service optimization, shorter routes result in a higher unit cost.

Cost per equivalent km offered

Measures the **unit cost related to the theoretical amount of service made available**, expressed in scheduled equivalent kilometers.

$$€_{km\_eq} = \frac{total\ operating\ costs}{equivalent\ km\ offered}$$

The indicator enables ex ante assessments of sustainability and comparisons between models with different service intensities, assuming a standardized conventional metric.

This KPI **is applicable** only to **DRT services** that have a **semi-fixed configuration** or guaranteed coverage on a spatial and hourly basis (e.g., basic routes with detours or network of points served with hourly availability), while **it does not lend itself to fully dynamic point-to-point models with** no predefined service structure.

Traffic revenue per km

Indicates the amount of **revenue generated from the sale of tickets** (including any refunds for fare concessions/exemptions) **per kilometer produced**:

$$€_{vehicle-km} = \frac{traffic\ revenue}{actual\ km\ (reported)}$$

The indicator provides an element of **assessment of economic performance in terms of attractiveness and fare participation by users**. It can also be used to compare different areas or successive time periods.

Cost coverage rate

It expresses **the degree to which the service is self-supporting**, that is, the proportion of costs covered by traffic revenues.

$$coverage\ ratio = \frac{traffic\ revenue}{operating\ cost}$$

The value can be defined as a minimum threshold to be achieved or as an indicator for informational use only, depending on the type of contract applied and the purposes of monitoring. It is consistent with the provisions of Article 19 of Legislative Decree 422/1997.

8.3.4. KPIs of Integration with TPL

Although not included among the minimum indicators provided for in Annex 7 of ART Resolution 64/2024, KPIs of integration with the local public transport network may be particularly **relevant** in the case of DRT services, where they are conceived as **complementary or adduction systems to the structured network**. The inclusion of these indicators in the service contract is intended as a proposal in an operational key, functional to verify the DRT's contribution to the overall coherence of the mobility system.

Intermodality of users

This indicator assesses **the extent to which DRT passengers also use other public transport services from the same trip**. It can be measured by integrated travel data, O/D analysis, or dedicated surveys.

The data collected make it possible to estimate the proportion of users who make at least one interchange between DRT and LPT (road or rail), indicating **whether DRT actually functions as a complementary mode to the structured network**. The value can be expressed as the percentage of DRT users who use, on the same route, at least one other TPL service.

Number of DRT-TPL interchanges

Indicates the amount of **interconnections recorded between the DRT and the LPT network** in a given period, at the node or origin/destination level. The survey can be done by:

- Analysis of travel sequences on integrated electronic ticketing systems;
- Tracking on digital platforms (travel planner, booking apps);
- Estimates from shipboard surveys or external surveys.

The value can be expressed as an absolute number or related to the total volume of passengers carried.

O/D monitoring for integrated DRT services

For integrated services, it may be useful to have an **indicator based on origin/destination matrices** to analyze the **actual flows generated by the DRT and their functional connection to the LPT network**.

This analysis makes it possible to **show whether DRT actually intercepts first- or last-mile demand** and whether **connection points are functionally located** with respect to prevailing mobility flows.

8.3.5. Comparison and general considerations

The comparison between the proposed indicators for DRT services and those contained in Annex 7 of ART Resolution No. 64/2024 should not be understood as a direct overlap. In fact, Annex 7 defines a minimum set of KPIs for local public road transport, referring mainly to services with fixed timetable and predefined route.

In the case of DRT, the application of these indicators requires **methodological adaptations**, **semantic reformulations** or, in some cases, **the introduction of specific indicators**, depending on the dynamic nature of the service. For example:

- the KPI "**regularity of rides**," defined in Attachment 7 as "*percentage of rides made on scheduled rides*," is reformulated in the DRT as the *percentage of requests honored versus reservations received*, changing the reference universe;
- the "**energy efficiency**" KPI, expressed as "*energy consumption per seat-km*," is difficult to apply in DRT services, where the vehicles used, the load carried and the routes vary dynamically;
- indicators such as **digital accessibility**, **demand-response capacity**, **intermodality**, or **connection to the TPL network**, while not provided for in Annex 7, are key to assessing the effectiveness and systemic integration of DRT services. Their introduction is an extension consistent with the principles of monitoring and transparency promoted by the Authority.

Functional category	KPI	Presence in Resolution ART 64/2024 Annex 7	Notes and specifics for DRT services.
Quality of service	User satisfaction	Present	Minimum standard KPI, directly applicable

Functional category	KPI	Presence in Resolution ART 64/2024 Annex 7	Notes and specifics for DRT services.
	Service rate/reliability	Adapted to the DRT context	Reformulated according to reservations, not on a fixed hourly basis
	Accessibility (physical and digital)	Adapted to the DRT context	Physical component provided; digital one is relevant addition for DRTs
Operational efficiency	Load factor	Present	Standard average load indicator, already included
	Productivity (passengers/km or hour)	Present	Included among the minimum indicators of the ART
	Efficiency of use	Not present	Useful for assessing the degree of actual utilization versus contracted availability. Highlights costs associated with downtime
	Punctuality and waiting time	Adapted to the DRT context	Rephrased punctuality: measured as meeting response time, not arriving on time
	Demand response capability	Not present	Proposed to assess the share of fulfilled requests in the total
Economic sustainability	Cost per passenger carried	Not present	Useful in comparisons between different DRT network types
	Operating cost per km / seat-km	Present	Planned among the essential economic KPIs
	Cost per equivalent km offered	Not present	Applicable only to DRT models with semi-fixed structure or guaranteed availability; useful for ex ante comparisons on a conventional basis
	Traffic revenue per km	Present	Included as revenue on a €/vehicle km basis
	Cost coverage rate	Present	Explicitly provided, consistent with Article 19 of Legislative Decree 422/1997
Integration with TPL	Intermodality of users	Not present	Proposed to measure the proportion of users who also use other TPL services
	Number of DRT-TPL interchanges	Not present	Indicator of effective modal connection
	O/D analysis for functional connection verification	Not present	Can be used in integrated or adduction-function models

Table 8-7 Functional comparison table between KPIs for DRT and ART indicators.

The "*adapted to DRT context*" KPIs and those proposed from scratch are therefore a **functional extension of the monitoring system**, aimed at ensuring the alignment of DRT service with the goals of accessibility, efficiency and economic balance required for integration into the LPT network.

The comparison presented confirms that a significant part of the KPIs provided for in Annex 7 of ART Resolution 64/2024 can also be applied to DRT services, **including through consistent and targeted reformulation with the on-demand logic and dynamic structure of these flexible services.** In other cases, the effective evaluation of DRT performance requires **specific indicators** not provided for in the national minimum framework, but fully **justified by the nature of the service** and its integrative function with respect to the ordinary network.