Car Evolution Mobility Operating System

A mobility orchestration layer for cities, campuses, resorts, airports, industrial parks, mobility operators and regions that need to coordinate transport capacity they already have.

AUDIENCE

Startup Estonia / EIS reviewers, city and mobility authorities, fleet and platform operators, distributors, technical due diligence readers

PRODUCT NAME

Car Evolution · Distributed Mobility Operating System · Mobility Control Center

SCOPE

Product architecture baseline. Advanced user, contract and economic modules are treated separately in Annex 5.

SECTION 01

Purpose

This annex defines the current Car Evolution Mobility Operating System as a product architecture.

Car Evolution is not presented here as a consumer app, a dashboard or a research concept. It is a mobility orchestration layer for cities, campuses, resorts, airports, industrial parks, mobility operators and regions that need to coordinate transport capacity they already have.

The product addresses a practical mobility problem:

> **People, fleets, public transport operators and authorities make mobility decisions at the same time, in the same territory, but usually without a shared operating layer.**

Car Evolution provides that layer: it converts demand, available capacity, policy constraints, scenario weights and live execution feedback into coordinated operating decisions.

SECTION 02

Product boundary

The current product claim is the orchestration/control capability.

It includes:

- mobility demand and capacity modelling;
- modular policy and restriction modelling;
- scenario weighting and comparison;
- route, service and capacity planning;
- route sheets and execution instructions;
- live operational feedback;
- affected-subspace replanning;
- KPI and governance reporting;
- integration through existing client/operator channels where available.

> It does not require OÜ JUBAP or the client to own vehicles. It does not require a city to provide every citizen's full agenda. It can work with different levels of data detail: individual commitments where authorised, or consolidated/aggregated demand where that is more appropriate.

Advanced user, contract and economic modules are treated separately in Annex 5. They extend the product but should not be confused with the existing orchestration core.

SECTION 03

Capability status labels

Every capability should be read with one of these states.

EXISTING

Implemented at least once in the historical operational orchestration system or evidenced by source/functionality material. It may still require modernization and adaptation for a new deployment.

INTEGRATED

Implemented with an external provider, source system, data import or operating channel in the historical material. A target deployment may use equivalent providers.

ADAPTATION

Productization work needed for a specific city, fleet, operator, data model, workflow, legal context, KPI set or channel.

POC / EXTENSION

A bounded module around the core, treated in Annex 5: user-facing layer, carpooling add-on, edge agentic assistant, negotiation, dynamic pricing, contracts, settlement, payments and flexible public-transport modules.

RESEARCH

Future extension work, treated outside the product claim.

SECTION 04

What the system does

Car Evolution turns mobility demand and available transport capacity into coordinated operating plans.

It supports decisions such as:

- when users should leave to improve arrival confidence;
- which routes, stops, pickup sequences or departure windows should be used;
- where capacity should be reinforced;
- when taxis, VTC, partner fleets, shuttles or reserve units should be relocated;
- when carpooling access or shared-trip incentives should be activated;
- which zones, corridors, gates or points of interest should be opened, restricted or prioritised;
- which vehicle classes, emissions labels or service types should receive priority;
- which scenario best balances punctuality, congestion, CO2, cost, accessibility and policy compliance;
- which part of a disrupted plan should be repaired without recalculating the full network.

> **This is the distinction from monitoring.** A dashboard shows a condition. Car Evolution turns the condition into candidate actions, compares their effects and produces operating instructions through channels the client already controls or can reasonably activate.

SECTION 05

Stakeholder outcomes

5.1 · CITIZENS AND MOBILITY USERS

The user outcome is confidence, not merely information.

- expected arrival confidence;
- recommended departure time;
- suggested route, itinerary or journey plan;
- weekly or repeated-trip transport-cost visibility;
- practical alternatives before and during disruption;
- alerts and rerouting when the user is subscribed or reachable;
- reduced uncertainty when different modes are involved;
- clearer trade-off between cost, time, sharing, walking, detour and arrival risk.

EXISTING | ADAPTATION for arrival-time, route, status and operational logic

POC / EXTENSION for the full edge agentic user layer, calendar import, behaviour learning and consent dialogue

5.2 · AUTHORITIES AND MOBILITY GOVERNANCE

The authority outcome is executable policy.

- policy by zone, corridor, gate, stop, point of interest or event perimeter;
- policy by time window, day type, event state or disruption state;
- policy by vehicle type, subtype, tag, provider, emissions label or user class;
- scenario comparison before activation;
- dynamic allocation of transport resources;
- access windows such as carpool-only, low-emission priority or accessibility exceptions;
- public transport reinforcement toward a corridor or zone;
- taxi/VTC/fallback-provider positioning;
- secondary-effect analysis: waiting time, congestion, extra capacity, cost, emissions estimate and policy compliance.

EXISTING | ADAPTATION for policy, weighting, scenario and control logic; Adaptation for local legal, enforcement, data and communications channels

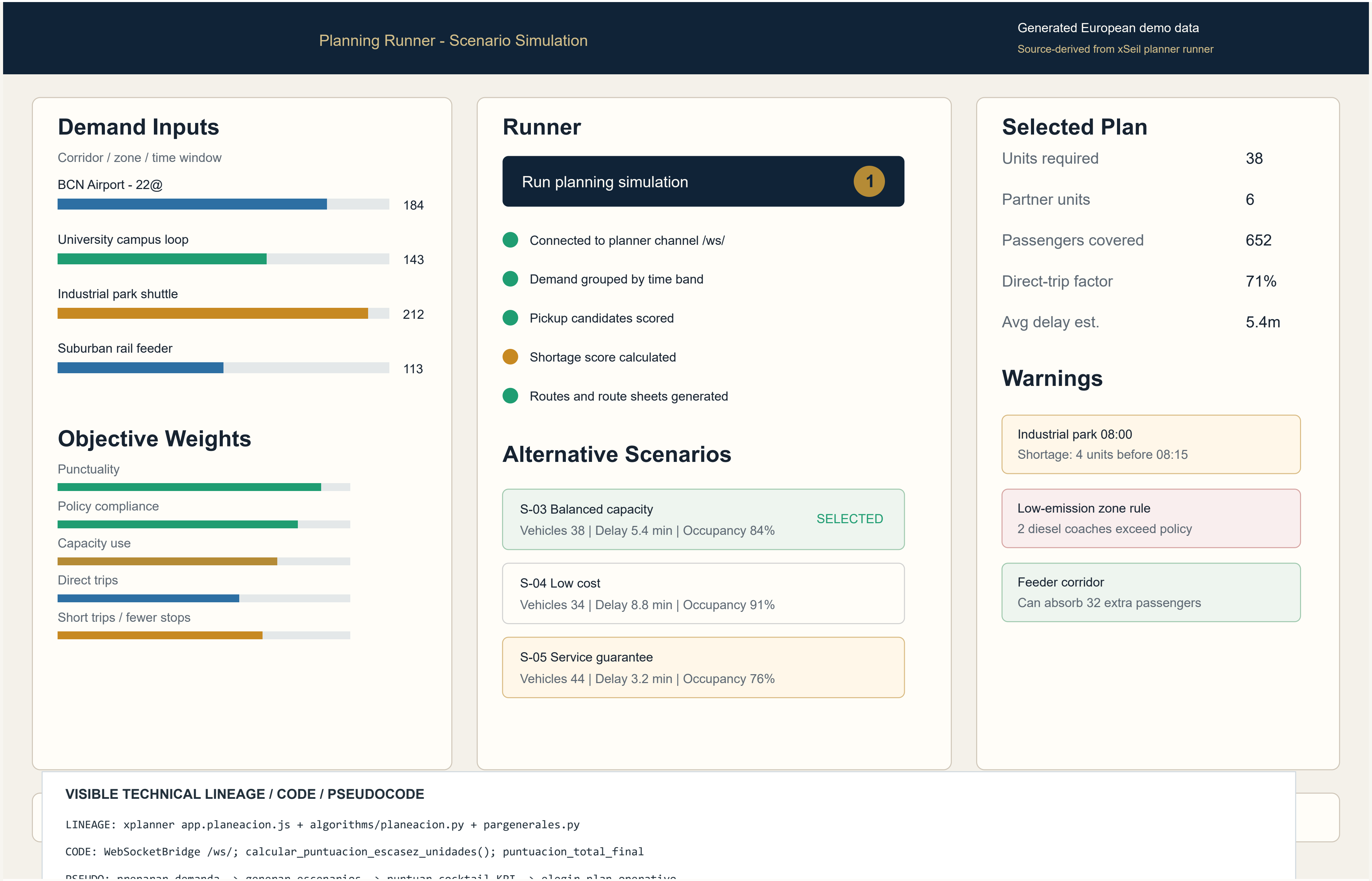


FIGURE 5.1 · SCENARIO GENERATION BEFORE ACTIVATION

SOURCE-DERIVED EUROPEAN MOBILITY ADAPTATION · GENERATED EUROPEAN DEMO DATA

5.3 · FLEETS, OPERATORS AND EXISTING PLATFORMS

The fleet/operator outcome is reliability across agents.

- route and schedule confidence for clients;
- demand-capacity planning before peaks;
- better use of existing capacity;
- route sheets and operating instructions;
- coordinated fallback when one provider cannot absorb disruption;
- KPI reporting by provider, route family, zone, vehicle type or time window;
- integration with fleet-control, dispatch, booking, AVL/GPS, mapping or operational systems.

EXISTING | INTEGRATED | ADAPTATION depending on the target stack

SECTION 06

Core architecture

The product can be read as a ten-layer operating loop.

	COMPONENT	TECHNICAL ROLE	STATE
1	**Mobility commitments and demand**	Origin/destination, pickup windows, arrival targets, service class, accessibility, recurrence, waiting and detour tolerance.	EXISTING ADAPTATION
2	**Available capacity**	Public transport, buses, shuttles, institutional fleets, corporate mobility, taxis/VTC, carpooling capacity, shared vehicles, voluntary private participants and reserve providers.	EXISTING ADAPTATION
3	**Demand grouping and abstraction**	Allows operation from individual commitments or from consolidated demand such as OD matrices, cohorts, corridors, events, ticketing, parking demand or operator forecasts.	EXISTING METHODOLOGY ADAPTATION
4	**Modular policy engine**	Rules by vehicle class, emissions label, service type, provider, zone, micro-zone, corridor, gate, point of interest, time window, user class, preference level and exception.	EXISTING ADAPTATION
5	**Scenario and weighting engine**	Compares punctuality, cost, CO2 estimate, congestion, occupancy, directness, extra capacity, access policy, fairness, accessibility and other KPIs.	EXISTING ADAPTATION
6	**Governance and selection**	Makes trade-offs explicit so an authority/operator chooses a named operating scenario rather than receiving a hidden algorithmic result.	EXISTING ADAPTATION
7	**Instructions and route sheets**	Produces route sheets, departure windows, pickup/drop-off sequences, vehicle/provider assignment, access permissions, alerts and fallback actions.	EXISTING
8	**Channels and integration**	Sends decisions through dispatch, mobile views, municipal apps, APIs, fleet systems, control rooms, manual procedures or approved provider channels.	INTEGRATED ADAPTATION

	COMPONENT	TECHNICAL ROLE	STATE
9	**Live execution and reality loop**	Captures executed and non-executed trips, no-shows, go-shows, boarded passengers, delays, cancellations, vehicle failures, demand changes and incidents.	EXISTING ADAPTATION
10	**Controlled replanning**	Preserves feasible parts of the plan and recomputes only affected routes, groups, vehicles, providers, zones, resources or time windows.	EXISTING ADAPTATION

SECTION 07

End-to-end operating flow

The operating flow is simple enough for an urban mobility team to read, but it preserves the real control logic: baseline reconstruction, scenario weighting, capacity-gap estimation, route-sheet style instructions, operational truth and bounded replanning.

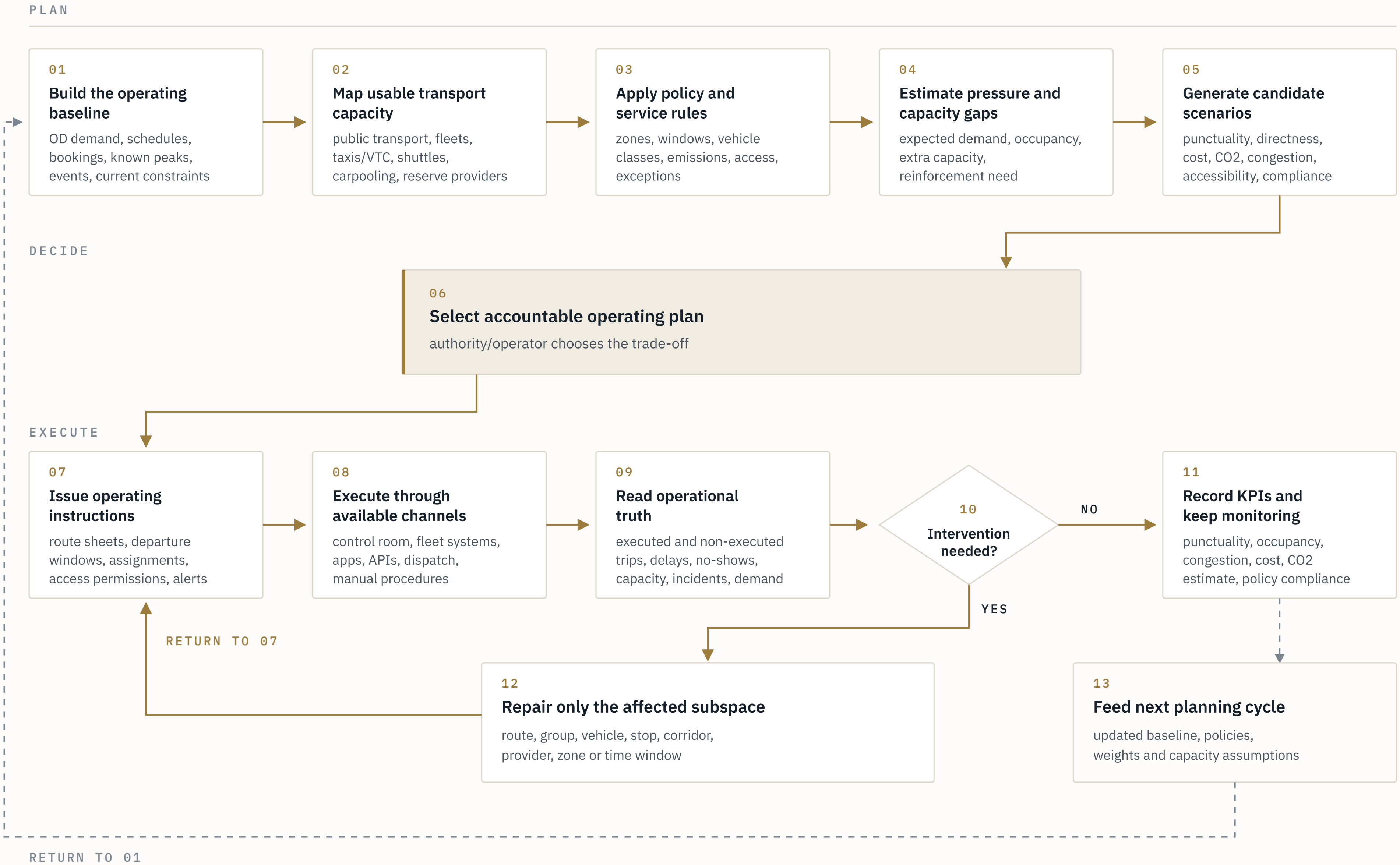


FIGURE 7.1 · END-TO-END OPERATING FLOW

GENERATED EUROPEAN DEMONSTRATION DATA · NOT A LIVE DEPLOYMENT

01 The system first reconstructs the usable operating baseline: demand, schedules, known peaks, events, service obligations and policy constraints.

02 It maps the capacity already available or activatable: public transport, fleets, taxis/VTC, shuttles, carpooling, partner capacity or reserve vehicles.

03 Policies convert public and operator priorities into executable constraints by zone, time, vehicle class, access rule, exception and service level.

04 Before execution, the system estimates pressure and capacity gaps so the authority can see whether extra capacity or reinforcement may be needed.

05 Candidate scenarios are generated and scored under the selected weights: punctuality, directness, cost, CO2 estimate, congestion, accessibility and policy compliance.

06 The authority or operator selects an accountable operating plan. The trade-off is visible.

07 The plan becomes instructions: route sheets, departure windows, vehicle/provider assignment, access permissions, alerts, reinforcement or relocation actions.

08 Execution uses available channels instead of requiring replacement of every existing system.

09 The system reads operational truth: what was executed, not executed, delayed, cancelled, overloaded, newly requested or disrupted.

10 If the plan still holds, KPIs are recorded and monitoring continues. If reality breaks part of the plan, only the affected subspace is repaired and new instructions are issued.

Dynamic Route Sheet - Reassignment

Generated European demo data
Source-derived from xSeil hoja dinamica

Assigned Units

EU-BUS-018 | Route R-128
27 pax | guide ok | driver ok | delayed +7m

EV-VAN-042 | Route R-133
8 pax | accessible | on time

PT-BUS-207 | Route R-145
31 pax | public partner | planned

Passenger Clusters

Sant Cugat hub - 9 pax

Diagonal campus - 6 pax delayed

22@ east - 12 pax

Pickup / Drop-off Sequence

07:42 Base release
Policy window: 07:35-07:50

08:05 Sant Cugat hub
9 pax confirmed, +3m variance

08:21 Diagonal campus
6 pax late, reassignment candidate

08:38 22@ east
12 pax, pickup order can change

09:04 City innovation district
drop-off target

09:20 Partner fallback available
taxi/VTC if SLA cannot be held

Control Instruction

Delay detected
Passenger cluster affects route R-128
Decision space: 2 nearby units

Suggested Reassignment

Move 6 pax to EV-VAN-042
Recreate route sheet
Keep R-128 arrival SLA
Cost delta: +EUR 18 estimated

Approve reassignment

Search alternatives

Audit Trail

08:14 delay event
08:15 combination search
08:16 route-sheet recreation

VISIBLE TECHNICAL LINEAGE / CODE / PSEUDOCODE

```
LINEAGE: hojadinamica index.js + admin.py + daemon.py
CODE: show_hojas_for_pax(); search_combination_for_hoja_and_pax(); recrear_hojaruta()
PSEUDO: detectar incidencia -> buscar hoja con plazas -> probar combinacion -> recrear ruta
```

FIGURE 7.2 · STEPS 07 AND 12 · ROUTE SHEETS AND AFFECTED-SUBSPACE REPAIR

SECTION 08

Data model and inputs

Car Evolution can start with imperfect but useful data. A smart-city deployment does not need to wait for universal instrumentation.

Possible inputs:

- OD matrices;
- recurring journey patterns;
- campus, school, employer or event demand;
- ticketing and booking records;
- parking and access-control signals;
- operator forecasts;
- fleet position and availability;
- planned and actual service status;
- public transport schedules and disruptions;
- voluntary user commitments;
- mobility-platform records;
- traffic, weather, event and incident data where available.

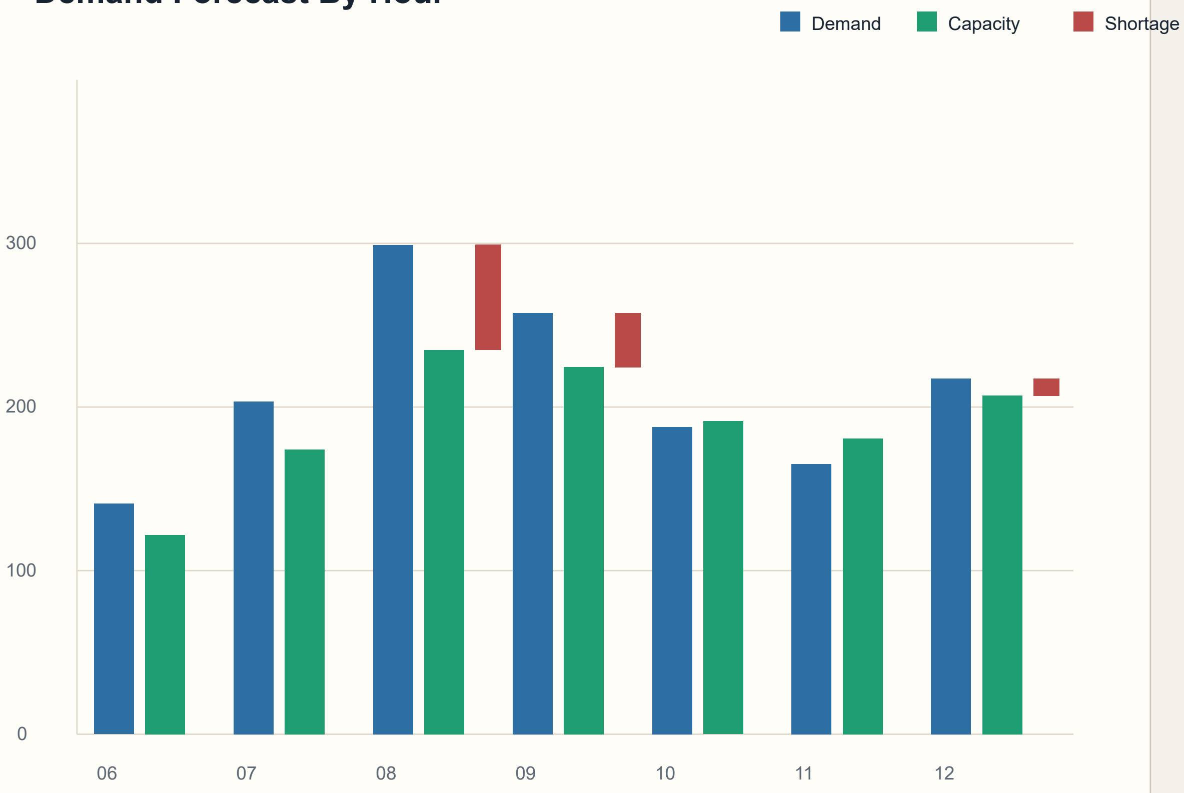
> The level of granularity is a deployment choice. Some deployments may use individual commitments; others may begin from corridor, zone, cohort or aggregated demand.

Demand / Extra Unit Estimation

Generated European demo data

Source-derived from xSeil planning and unit estimation

Demand Forecast By Hour



Reinforcement Recommendation

08:00 peak shortage

Estimated missing capacity: 74 seats

Suggested: 3 public buses + 2 shared vans

Expected effect

Punctuality +9 pts | CO2 -14% | cost +EUR 260

Capacity use remains above 81%

Provider Mix

Public transport reserve 70%

Taxi / VTC fallback 30%

Institutional fleet 80%

Shared private vehicles 50%

VISIBLE TECHNICAL LINEAGE / CODE / PSEUDOCODE

```
LINEAGE: estimar_rentas.py + planeacion.py + unidades.py
CODE: pax_estimados = pax_actuales * promedio_total / promedio_hora; unidades = demanda/plazas
PSEUDO: leer curva historica -> estimar demanda final -> recomendar unidades extra/provider
```

FIGURE 8.1 · DEMAND AND EXTRA-CAPACITY ESTIMATION

SOURCE-DERIVED EUROPEAN MOBILITY ADAPTATION · GENERATED EUROPEAN DEMO DATA

SECTION 09

Policy and constraint model

Policies are modular and combinable.

Examples:

- only shared or carpooling vehicles may access a zone between 07:30 and 09:30;
- a low-emission vehicle class receives priority in a corridor;
- a public transport corridor is reinforced today because demand has shifted;
- taxis/VTC or fallback providers are moved toward an expected demand hotspot;
- a restriction excludes accessibility, emergency or special-permit services;
- an event perimeter distributes flows across several access points;
- a campus or industrial park activates different rules for staff, visitors and providers;
- a route may leave a standard pattern only within a defined tolerance;
- private participating vehicles are routed away from a saturated area where channels exist.

POLICY CAN BE DEFINED BY

Geography	city, district, micro-zone, corridor, gate, stop, station, point of interest
Time	window, day type, season, event, disruption state
Actor	public transport, taxi/VTC, fleet, shuttle, shared vehicle, private participant, accessibility service
Vehicle	class, subtype, emissions label, occupancy, capacity, provider tag
User / service	passenger class, priority, accessibility need, exception category
Action	permission, restriction, warning, incentive, charge, fallback or reinforcement

SECTION 10

Scenario and KPI system

The KPI system is modular and hierarchical. New KPIs can be added and linked to local policy objectives.

FIGURE 10.1 · SCENARIO WEIGHTS AND POLICY OBJECTIVES

CORE KPI FAMILIES

- punctuality and arrival confidence;
- travel time and waiting time;
- congestion ratio;
- directness and route-standard departure;
- occupancy and capacity utilisation;
- extra-capacity need;
- cost by provider, route family or scenario;
- CO_2 / fuel / vehicle-km estimate;
- policy compliance by zone, vehicle type, provider or time window;
- accessibility and maximum disadvantage limits;
- resilience after disruption;
- operator efficiency and schedule reliability.

SCENARIO EXAMPLES

- reduce CO_2 while accepting a small increase in waiting time;
- improve punctuality by activating reserve vehicles or taxis;
- reduce congestion with fewer access restrictions by moving demand to carpooling;
- protect accessibility while applying stricter solo-driving restrictions elsewhere;
- reinforce public transport today in one corridor with changed resources toward that zone;
- keep more routes direct while accepting a higher capacity requirement;
- minimise extra units while allowing slightly longer detours;
- compare all combinations of policy, capacity, cost, punctuality and emissions weights that the authority chooses to test.

SECTION 11

Execution and integration

The product is designed to sit above existing systems. It can coordinate without replacing every local platform.

Execution channels may include:

- fleet-control systems;
- dispatch tools;
- route sheets;
- driver or operator mobile views;
- municipal or transport-authority apps;
- carpooling platforms;
- APIs;
- access-control systems;
- SMS/email/manual procedures where a low-tech channel is more reliable;
- control-room workflows.

> Historical source material shows integration patterns with mapping, telemetry and operational imports. In a new deployment, the equivalent providers are mapped during the local adaptation phase. Examples include Google Maps or another approved GIS layer, GeoTab or equivalent AVL/GPS/fleet telemetry, booking/reservation imports, dispatch systems and operator databases.

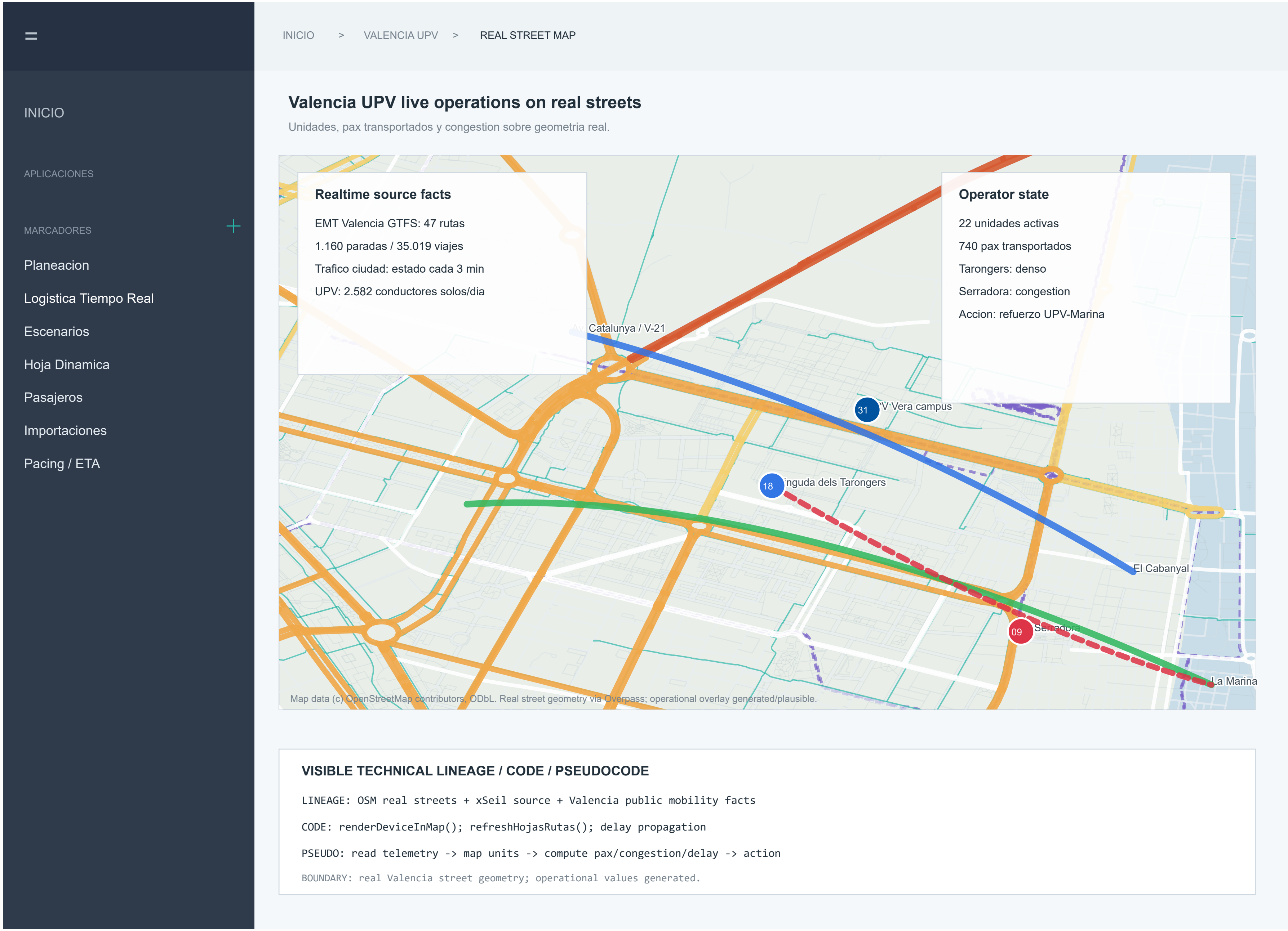


FIGURE 11.1 · CONTROL-ROOM WORKFLOW · LIVE OPERATIONS, VALENCIA UPV

REAL VALENCIA STREET GEOMETRY (OSM) · OPERATIONAL VALUES GENERATED

SECTION 12

Product boundary against extensions

The distinction is important for product credibility. This annex defines the Mobility Operating System product core. Advanced user, platform, negotiation, contract and settlement modules are preserved in Annex 5 and should be read there, not folded into this product annex.

EXISTING / ADAPTABLE PRODUCT CORE

- central mobility/logistics orchestration;
- scenario planning and weighted trade-offs;
- control-center operating logic;
- route sheets and operational instructions;
- passenger/trip execution states;
- map-based control patterns;
- capacity and extra-unit estimation;
- modular policy and KPI translation;
- partial replanning after disruption.

SECTION 13

Relationship to the other annexes

02	Historical/source evidence and code-derived proof. It can name the historical systems and show technical evidence.
03	Research and validation lines, including external research pathways and boundaries.
04	Alignment with smart-city requirements.
05	Advanced PoC modules around user layer, carpooling, edge agentic assistants, negotiation, pricing, contracts and settlement.
06	Planned. Product-fit and competition comparison.
07	Planned. Commercialization, first commercial steps, distribution and Startup Estonia go-to-market logic.

> This annex is the product architecture baseline. It should be the first technical document reviewed before web copy, investor text or Startup Estonia application language is finalised.