| **KPI** | **Meaning** | **Academic Use** | **Industry Use** | **Extractable From** |
| --- | --- | --- | --- | --- |
| 🚧 **Minimum Headway** between trains | Safety + capacity efficiency indicator | Analyze how VC compresses headway | Infrastructure planning, capacity utilization | tripinfo.xml, custom processing |
| ⏱ **Average Delay** | Difference between scheduled and actual arrival | VC vs. fallback strategies | Service punctuality, customer satisfaction | tripinfo.xml, reference timetable |
| 🚆 **Train Density** (trains per km) | Network load metric | Congestion analysis, VC tradeoffs | Capacity analysis, bottleneck detection | Custom SUMO counters |
| 💨 **Average Speed per Vehicle Type** | Operational performance | Effects of VC on cruise speeds | Rolling stock utilization | tripinfo.xml |
| ⛽ **Energy Proxy (emissions or braking events)** | Proxy for energy use | Analyze braking behavior under fallback | Energy savings potential of VC | emissions.xml or brake frequency (custom sensors) |
| 📍 **Dwell Time at Stations** | Boarding/alighting impact | Simulate control strategies | Schedule adherence, passenger flow | stop-output.xml |
| 📉 **Throughput at Key Nodes** | Trains/hour at bottlenecks | Network scalability | Station design, node signaling impact | Custom edge counters |
| 📊 **VC Compatibility Ratio** | Share of network or trains VC-compatible | Simulation scenario control variable | Investment planning metric | Defined in simulation setup |

**💼 KPIs That Help in Industry Job Interviews / Portfolios**

If you present your work to a recruiter or hiring manager at:

* **DB Netz, SBB, Siemens Mobility, Deutsche Bahn Cargo, Thales, Alstom, Stadler**, etc.

You want to highlight:

* 🚄 *“I simulated high-speed and mixed traffic with a safety-aware virtual coupling algorithm and measured its effects on minimum headway and system throughput.”*
* 🧠 *“My simulation platform allows energy-aware decision making by correlating braking events and speed profiles to power consumption proxies.”*
* 📉 *“I computed KPIs used by real-world infrastructure operators — average delay, throughput, density — all in a modular, Python-based system linked to SUMO.”*

**✅ Suggested KPI Categories for Your Project Structure**

**1. Safety & Capacity**

* Min headway
* Max throughput
* Density

**2. Efficiency & Performance**

* Average speed
* Delay vs. reference
* Dwell time

**3. Energy & Behavior**

* Braking frequency (VC fallback)
* Emission proxy (optional)

**4. Control System Impact**

* VC compatibility ratio
* Dynamic routing success (later phase)