

COVESA

Accelerating the future of connected vehicles

EVOLVING TOWARDS A VEHICLE DATA MODEL (VDM) FOR LONG-TERM BUSINESS VALUE

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1. Background

The VSS Journey

The [Vehicle Signal Specification \(VSS\)](#) has been a cornerstone of COVESA's work for nearly a decade. It provides a controlled vocabulary¹ of vehicle properties in a simple, hierarchical format, enabling Subject Matter Experts (SMEs)², not just data modeling specialists, to contribute to and maintain the model.

This approach has brought and continues to bring significant value:

- Widespread industry adoption.
- Consistent, shareable definitions for vehicle signals.
- Low barrier to entry for contributors.

Where VSS Meets its Limits

As vehicle ecosystems expand, the scope of required data models grows:

- Vehicles now interact with **charging networks, smart city infrastructure, mobility services, and cloud platforms**.
- Business models increasingly require **multi-domain³ integration**. For example, connecting vehicle telemetry to urban traffic control or fleet management.

The current VSS modeling approach, while accessible, has limitations:

- Its **YAML-based syntax** is not natively understood by common modeling tools.
- **No native cross-domain references**, making it difficult to connect models across vehicle and non-vehicle domains.
- **Limited metadata and semantic capabilities** can make governance and evolution challenging.

2. Continuity and Evolution: Two COVESA Artifacts

COVESA's current VSS ecosystem consists of two main deliverables:

1. **The modeling [rule set/approach](#) and tooling:** the [VSS Ruleset \(vspec\)](#) language and [vss-tools](#) for authoring, validating, and exporting models.
2. **The [catalog of vehicle signals/concepts](#):** the VSS property hierarchy.

¹ *Controlled Vocabulary: A standardized set of terms used to organize, describe, and retrieve information consistently (e.g., vehicle speed).*

² *Subject Matter Experts: A person with deep, specialized knowledge in a particular field, topic, or process, serving as an authority to guide, inform, and solve problems for an organization (e.g., embedded engineer).*

³ *Domain: A specified sphere of activity or knowledge.*

The Vehicle Data Model (VDM) initiative builds on this proven structure:

- **Artifact 1 – [The modeling approach](#)** will evolve to utilize widely adopted open standards (GraphQL SDL and SKOS) for enhanced interoperability, polyhierarchies, and improved tool support.
- **Artifact 2 – The catalog** will continue to exist and be maintained, but can be authored using the new approach, gaining richer semantics and more flexible classification without losing SME accessibility.

Why this matters: We keep the same **two-artifact model** that stakeholders already understand. We're simply upgrading the underlying technology for future scalability and integration.

3. What is VDM and Why is it Needed?

The Vehicle Data Model is COVESA's next step in data modeling maturity.

It builds on the principles of VSS — simplicity, accessibility, and community ownership — while improving the flexibility, governance, and interoperability needed for the next decade of connected mobility.

VDM is not a replacement for VSS. Instead:

- **VSS remains** the SME-friendly, vehicle-centric controlled vocabulary.
- **VDM complements it** by using **open, web-friendly specifications and standards** to extend modeling capabilities across domains and integrate with widely adopted modern tooling.

VDM uses:

- **GraphQL Schema Definition Language (SDL):** for defining structured, typed models that can be introspected and exported into other formats (JSON Schema, SHACL, etc.).
- **Simple Knowledge Organization System (SKOS):** for flexible classification and polyhierarchies, allowing concepts to be categorized in multiple ways.

4. The Business Value of VDM

Organizational and Market Benefits

VDM enables organizations to:

- **Integrate faster** with external partners and ecosystems by using standards recognized beyond the automotive sector.
- **Reduce duplication** of work by reusing a shared, governed conceptual model.
- **Accelerate partner onboarding**, a common modeling language means less time translating and reconciling data definitions.

Flexibility to Model Vehicle and Adjacent Domains

While VSS focuses on vehicle properties, VDM is designed with the flexibility to extend into adjacent domains. This enables the support of broader ecosystems that interact with vehicles. For example, VDM can be used to model:

- **Charging systems:** Enable integration of charging station data with vehicle battery state.
- **Fleet operations:** Track vehicle usage alongside driver profiles and maintenance records.
- **Urban infrastructure:** Link vehicle telemetry to smart traffic management or parking systems.



These examples illustrate the broader applicability of the VDM approach beyond the vehicle itself.

In addition, VDM can also be extended to support emerging cross-domain business models like:

- Mobility-as-a-Service (MaaS)
- Vehicle-to-Grid (V2G)
- Vehicle-to-Everything (V2X)

Technical and Ecosystem Benefits

Leverage a Larger Community

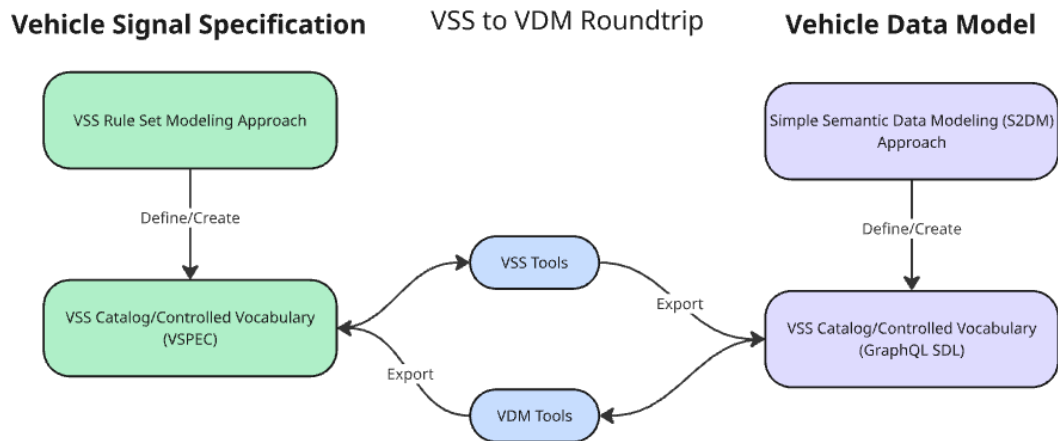
- GraphQL (GraphQL Foundation) and SKOS (W3C) are **open source ecosystem specifications**.
- Abundant **open tooling exists**: schema editors, validators, code generators, data catalogs.
- Easier to **find skilled contributors**.

Well-Known and Supported Paradigm

- GraphQL SDL is **developer and architect-friendly**, with strong adoption in API and data modeling communities.
- SKOS is **widely used in libraries, archives, and enterprise data catalogs**, ensuring interoperability.

Evolving VSS

- VSS **remains** for simple, vehicle-only cases.
- VDM **expands** modeling capabilities without forcing everyone into a single approach.
- The two can **coexist**, and even share the same concepts, thanks to mapping and export capabilities.



Key Benefits at a Glance

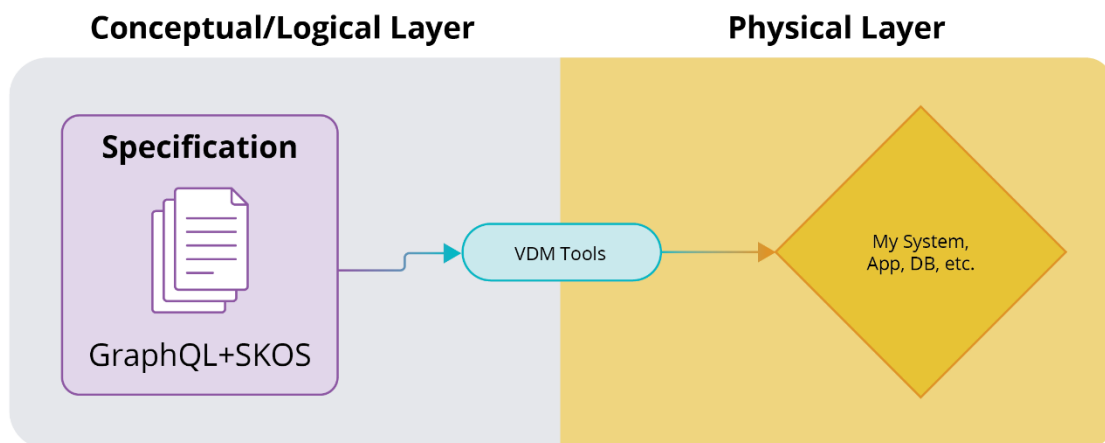
Business Question	VDM Answer
What can I do with VDM that VSS alone can't?	Model across domains, link to external vocabularies, and use richer governance tools.
How does it save time/money?	It avoids duplication, reduces rework, and uses widely available tooling.
Does it make data easier to manage?	Yes, VDM has future-proof identifiers, searchable classifications, and can be exported into any needed format.
Will it help me deliver faster?	Yes, it accelerates integration with external domains and partners.
Do I need new hires?	No, existing staff can learn it quickly; many already know GraphQL.
Does it tie me to one vendor?	No, VDM is fully standards-based and open.

5. Conceptual to Physical: How VDM Works

A key principle of VDM, aligned with data-centric architecture, is that concepts are modeled once and then reused everywhere.

High-level workflow:

1. **Conceptual Layer:** SMEs define entities and properties using GraphQL SDL + SKOS.
2. **VDM Tools:** Check for compliance, manage IDs, export into needed physical formats.
3. **Physical Layer:** Downstream systems (databases, APIs, streaming platforms) consume the generated schemas. There is no need to remodel data.



6. Real-World Scenario: Faster Integration

Imagine a manufacturer who wants to connect its vehicles to a new city parking system:

- With VSS alone: The parking system's data model and the vehicle's need to be manually mapped and reconciled.
- With VDM: Both domains can reference shared concepts (e.g., location, vehicle status), and the tools export a ready-to-use schema for the integration layer.

Result: Weeks of integration reduced to days, fewer errors, and easier long-term maintenance.

7. Coexistence with VSS

VDM is **not** a "replacement" project; it is a **complementary track**:

- **VSS stays** where its simple YAML format and single-domain focus are a perfect fit.
- **VDM steps in** when cross-domain modeling, richer metadata, or advanced tooling is needed.
- Concepts can be **mapped between VSS and VDM**, ensuring investment protection.

8. Conclusion

VDM represents a strategic evolution in COVESA's data modeling capabilities:

- **Keeps the simplicity** that made VSS successful.
- **Adds scalability, governance, and interoperability** for future business needs.
- Positions COVESA members to **lead in the rapidly converging mobility, infrastructure, and data ecosystems**.

By adopting VDM alongside VSS, members gain:

- **Faster integration** and service delivery.
- **Reduced duplication** and rework.
- **Access to broader ecosystems** and tooling.

9. Call to Action

We invite everyone to:

- Visit the [Project Home](#).
- Join weekly meetings on Thursdays at 3 pm CET / 9 am ET / 6 am PT ([Community Calendar](#)).
- Review the VDM [approach](#) and identify where it can accelerate their projects.
- Participate in [pilot programs](#) to test cross-domain modeling.
- Contribute to governance discussions to ensure the model meets industry needs.

For more information on COVESA, including how to become a member and participate in our innovative projects, please visit the COVESA [website](#), [Wiki](#), or contact help@covesa.global.