

TAKAYA

Mussawer Ahmed

A CANADIAN BORN AUTOMOBILE



Takaya is not just meant to be a proof Canada can build a car.
It is a blueprint for how Canada can own one.

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Coming to Canada, one of the first things that surprised me was that a country with such a strong automotive presence did not have its own globally recognized car company. This curiosity led me to start researching initially out of interest, but quickly turning into a deeper question: how can a nation that builds world-class vehicles not have one of its own?

Mussawer Ahmed

Designer's Statement



HOW THIS STARTED

Canada is one of the most advanced automotive manufacturing nations in the world. We build the Ford GT, the Aston Martin Valkyrie, the Rivian technically demanding vehicles, built in Ontario. What I could not understand was why, with all **of that capability, Canada had never built something it owns.**

That question became the project. Not "can Canada build a car" that was already answered. The question was structural: **why hadn't it? What was preventing it?**

Every trade agreement since 1965 had reinforced Canada's role as supplier. The problem was structural, not technical.

Then the political context made it impossible to ignore.

American tariffs. Sovereignty pressure. A 92% export dependency on one trading partner.

The structural vulnerability of building everything for someone else became a national conversation. The question stopped being academic. It became urgent.

My role in this project is not to engineer every subsystem.

It is to design the system that makes all the subsystems possible. The car is the proof. The platform is the product.

The ecosystem is the design.

THE POLITICAL MOMENT — 2024-25

American tariffs on Canadian goods · Threats to Canadian economic sovereignty
92% vehicle export dependency exposed · Foreign automotive dominance
Takaya is the design response to a structural national problem.

WHY TAKAYA?

THE LONE COASTAL WOLF OF BRITISH COLUMBIA

Takaya was a lone coastal wolf who lived for years on small islands near Victoria, British Columbia surviving alone in a marine environment, far from any pack. He swam to remote islands, adapted to conditions no wolf had faced before. Documented by Cheryl Alexander, his story became the documentary **Takaya: Lone Wolf**.

Takaya represents resilience, independence, and adaptation surviving outside the structure everyone else depends on. That is the design intent for Canada: a platform that **operates independently of foreign OEM control**, adapts to Canada's unique industrial reality, and proves that survival outside the established **structure is not just possible, it is powerful.**

"What made Takaya special was not that he was a wolf. It was that he lived alone, adapted to an environment wolves had never inhabited, and survived in a way that felt almost impossible."

Design intent: Not the fastest. Not the biggest.
The most resilient.

PHOTOGRAPH BY CHERYL
ALEXANDER TAKAYA · LONE
WOLF VICTORIA, BC



PROJECT OVERVIEW

Canada's Automotive Gap.

This project began with one question: why has Canada one of the world's most advanced automotive manufacturing nations never produced a car it can call its own?

The answer is not capability. The answer is structure.

12th

m anuf ac ture r

1.29M

produced/yr

700+

m anuf ac ture rs

Zero

owned brands

WHAT CANADA BUILDS — FOR OTHERS

Ford GT : engineered + assembled by Multimatic, Toronto

Aston Martin Valkyrie : carbon monocoque by Multimatic, Toronto

Rivian R1T/R1S : assembled by Magna, Aurora, Ontario

Lucid Air : assembled by Magna, Aurora, Ontario

BMW X3/X4 drivetrains : Linamar, Guelph, Ontario

Corvette V8 : GM St. Catharines, Ontario

"We don't have a car company, yet we're the world's 12th largest automaker producing other people's cars.

Canada is left hanging in the wind."

— Flavio Volpe, President, APMA

Canada builds the most technically demanding vehicles in the world.

NotonecarriesaCanadianbadge.Thegapisstructural—andTakaya is the answer.



IMAGE
Canadian auto plant / Multimatic / performance vehicle built in Canada

CHAPTER 03 COVERS

P.08 Canada's Automotive Gap , you are here

P.09 Value Proposition ; the Virtual OEM in 3 roles

P.10 Insight / Idea / Impact ; three-panel synthesis

P.11 From Ecosystem to Vehicle ; research to car

P.12 The Designer's Role ; system

architecture

The Value Proposition.

A Virtual OEM. Not just a car company. A platform that operates in three roles simultaneously.

Takaya does not build everything.
It integrates everything.

01

Vehicle Producer

Produces 20–30 hypercars annually. Low volume, high value. Pre-sold before production begins. Supply on demand zero unsold inventory risk. Collectors and enthusiasts in global performance markets.

\$1.5M–\$2.2M CAD per unit

40–65% gross margin
No factory required
Crate model + Tier 1 suppliers

\$24–60M

02

Software Company

Owns and develops 9 core control systems. VCU. Torque vectoring. Thermal management. Battery SOC/SOH. Active aerodynamics. Brake-by-wire. ISO 26262 safety. All licensable to any OEM globally.

The Rimac model applied to Canada

Full platform deal: \$10–40M+/OEM
VCU + torque vectoring: \$2–8M/deal
ISO 26262 safety: \$2–10M/deal

\$10–40M+

03

IP Platform

Generates data and transferable technology deployable into defence, transport, and advanced mobility. Thermal + VCU into unmanned ground vehicles. Fleet efficiency. EV transit.

IP compounds every drive cycle

Defence: \$2–8M/contract
Fleet: crate module sales
OTA updates: \$20–60K/unit/yr

\$150M+

combined revenue at maturity

Unlike previous attempts Bricklin (capital only) and Project Arrow (capability only) —
Takaya operates as vehicle manufacturer, software company, and IP platform simultaneously.

Three revenue lines. One ecosystem. Permanently Canadian-owned.

Insight. Idea. Impact.

INSIGHT

The gap Canada has never filled

Canada builds the parts. Not the system.

Canada has world-class Tier 1 suppliers operating under foreign OEM NDAs. Each excels in one domain. None collaborate under a unified Canadian platform.

Design leadership, branding, and IP remain externally controlled.

This is not a capability gap.

It is a structural gap.

The missing element: a coordination layer that organizes existing Canadian capability into a coherent system.

700+ world-class suppliers.
Zero coordination platform above them.

That platform is Takaya.

IDEA

The Virtual OEM

A design-led integration platform.

MACRO Government, investors, suppliers aligned under one brief.

MESO 12 modular subsystems.
Takaya HQ: system integrator, design authority, IP creator.

Owns the architecture.

MICRO The hypercar. Proof of the system. All 12 crates integrated. Validated under hypercar load.

Data generated = IP owned.

Takaya does not build everything. It integrates everything.

IMPACT

From supplier nation to - creator nation

Industrial

Suppliers collaborate in one system, not in isolation.

Economic

IP ownership shifts value from production to innovation.

Strategic

Reduces foreign OEM dependence. Reduces trade volatility exposure.

Technological

Canada owns the most critical layer: software and control systems.

Cultural

Canada's first visible automotive identity. A flag to drive under.

A proof that Canada authors.

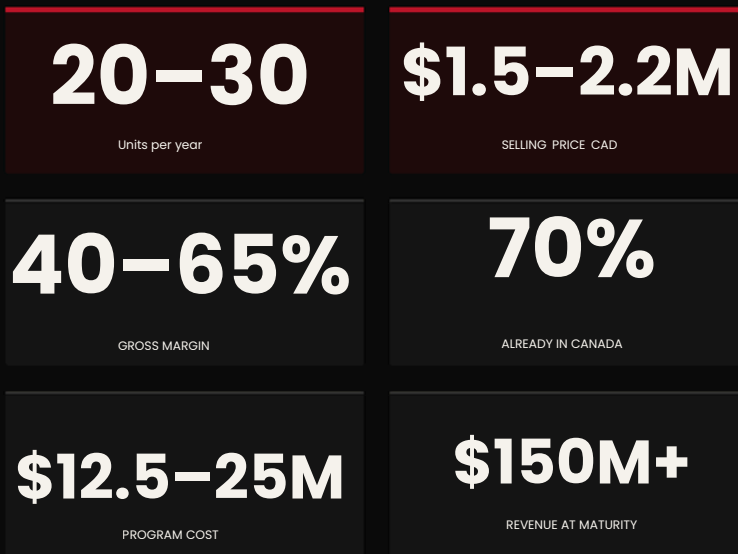
The gap was never the car. The gap was the structure.

The idea fills the structure. The impact transforms the industry.

Takaya is the first model designed to do all three simultaneously.

SUMMARY

The full picture. One page.



THREE PLATFORM LEVELS

MACRO
Government · Investors · Suppliers

MESO
12 modular subsystems

MICRO
Integrated hypercar output

THE PROBLEM

Canada is the world's 12th largest automotive manufacturer.
It has never produced a nationally owned brand.

Not because of capability. Because of structure. Every trade agreement since 1965 reinforced Canada's role as supplier. The Bricklin SV-1 and Project Arrow proved the engineering exists. What failed was the model.

THE INSIGHT

The problem was never the car. It was the system behind it.

Canada's Tier 1 suppliers Magna, Multimatic, Linamar, Martinrea, Dana TM4, produce world-class subsystems for every major OEM. What has never existed is a coordinated platform above them. Takaya introduces the Virtual OEM model: a design-led integration layer that organizes these capabilities into a unified, scalable, Canadian-owned system, without disrupting any existing OEM relationship.

THE SOLUTION — THREE ROLES

VEHICLE MANUFACTURER

20–30 hypercars annually.
Low volume. High value.
Pre-sold before production.
Supply on demand.
Zero unsold inventory risk.

SOFTWARE COMPANY

9 proprietary control systems.
VCU · Torque vectoring.
Thermal · Battery SOC.
Active aero · Brake-by-wire.
All licensable to any OEM.

IP PLATFORM

Data generated each drive.
Transferable IP.
Defence · Transport.
Advanced mobility. The Rimac
model, for Canada.

THE IMPACT

Industrial

Suppliers collaborate under one platform instead of isolation.

Economic

IP ownership shifts value from production to innovation.

Strategic

Reduces dependence on foreign OEMs and trade volatility risk.

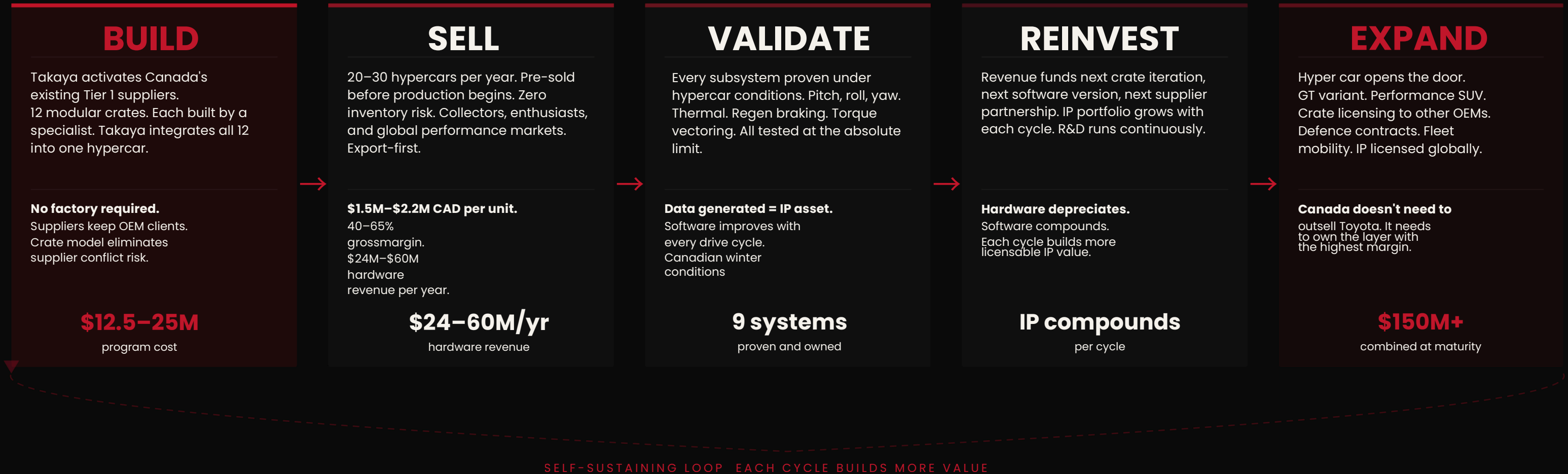
Cultural

Canada's first visible automotive identity. A flag to drive under.

Takaya is not proof Canada can design a car.
It is a blueprint for how Canada can own one.

The Business Loop.

A self-sustaining cycle. Each stage feeds the next. The IP compounds with every unit.



Why this loop works specifically for Canada:

Canada cannot win on volume. It wins on integration, software, and precision, exactly what this loop produces.

The hypercar is not the business. It is the proof of the business. Every drive cycle makes the IP more valuable.

Research Journey

This project began with a single question:

Why has Canada never produced a car it owns?

The initial research focused on Canada's automotive structure — manufacturing capacity, supply chains, and historical development. Canada plays a major role in global production, yet very few independent Canadian brands have ever emerged.

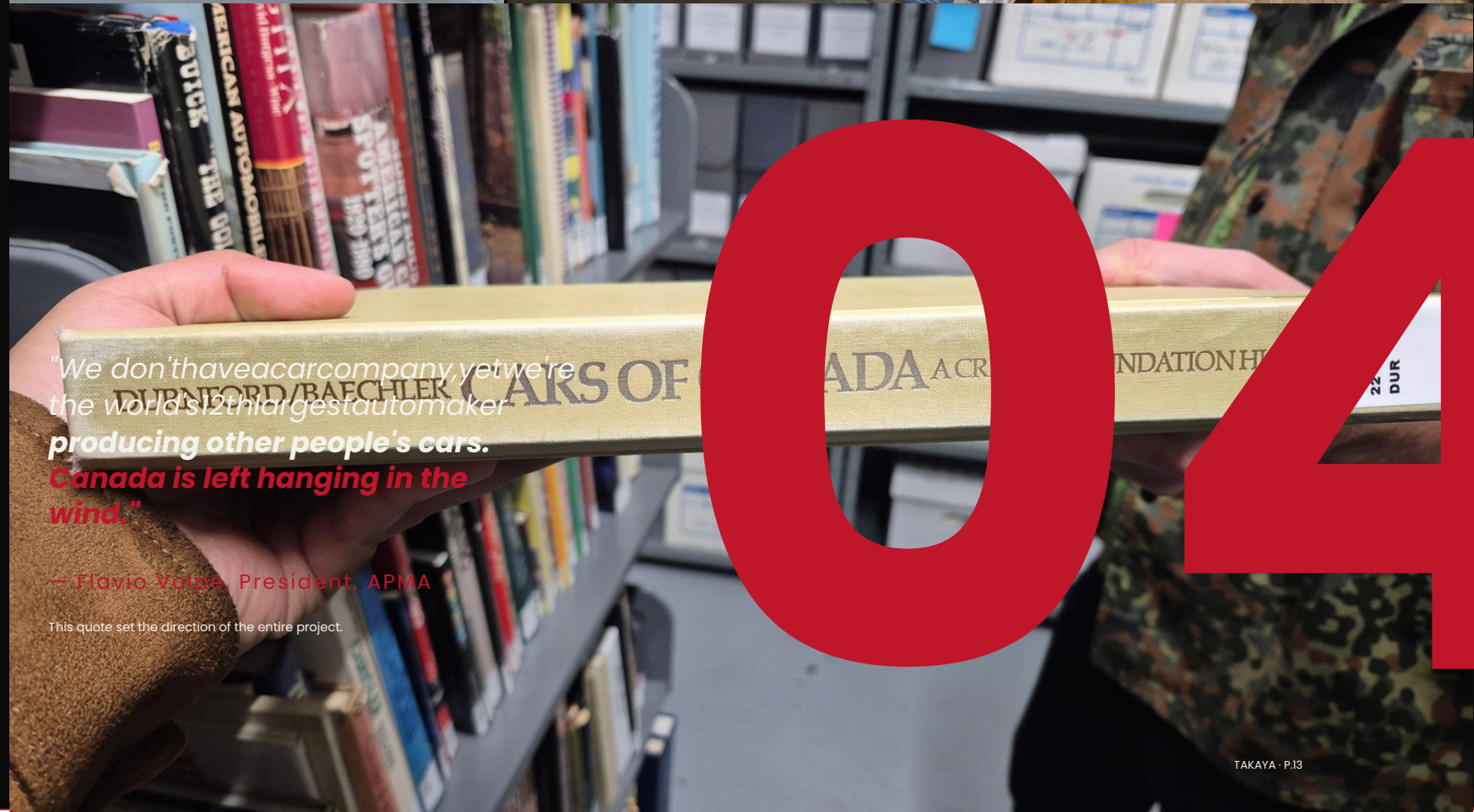
Understanding that contradiction led to the Canadian Automotive Museum in Oshawa and a conversation with Dumaresq de Pencier, Curator of Exhibits. Historical vehicles in that collection showed exactly how Canada's industry evolved: a manufacturing hub connected to larger international manufacturers never the author.

The structural realization:

Canada's strength lies in its distributed ecosystem of suppliers, engineers, and advanced manufacturers.

THIS CHAPTER COVERS

- American influence and the Auto Pact (1965)
- NAFTA, USMCA, and how trade shaped the industry →
- Canada's role in global performance cars
- Why full OEMs never formed
- The \$40B investment imbalance and 92% export rate



"We don't have a car company, yet we're the world's 12th largest automaker

producing other people's cars.

Canada is left hanging in the wind."

— Flavio Volpe, President, APMA

This quote set the direction of the entire project.

From Ecosystem to Vehicle.

This semester was not about designing the final car.
It was about understanding whether a Canadian performance vehicle could realistically exist and what structure would support it.
The research led to the system. The system led to the car.

SEMESTER 1 - ECOSYSTEM RESEARCH

Three gaps emerged from the ecosystem mapping:

- Canada lacked complete vehicle integration under one platform
- Canada lacked high-performance battery architecture it owned
- Canada lacked a unified powertrain architecture it controlled

SEMESTER 1 ESTABLISHED

- + Crate ecosystem model: coordination structure, not manufacturing
- + 12 core vehicle systems and their Canadian sourcing status
- + Halo hypercar as strategic entry point, not final destination
- + Three-tier platform: macro ecosystem, meso architecture, micro vehicle

SEMESTER 2 BUILT

- + Physical system architecture through prototyping
- + Vehicle dynamics as the basis for every subsystem decision
- + Aerodynamic and packaging logic leading to the final form
- + The hypercar as the integrated expression of the entire system

The car followed the ecosystem.

Every decision responded to a constraint, a capability, or a gap that became IP.
Form followed function followed physics. The ecosystem led.

RESEARCH JOURNEY FLOW

Stakeholdermapping

8 groups. Needs. Unmet value.



Ecosystem analysis

Suppliers, gov, investors, research.



Historical research

Auto Pact, NAFTA, Bricklin, Arrow.



Gap analysis

70% Canada has. 30% missing.



Crate model

12 subsystems. Coordination layer.



Platform structure

Macro / Meso / Micro defined.

American Influence + Auto Pact

From the beginning, Canada's automotive industry was built as an extension of American production not as a sovereignty. Ford, GM, and Chrysler established Ontario plants to serve both markets. Canada developed world-class manufacturing capability, but never owned the design, the brand, or the IP.

EARLY HISTORY

1904

Ford Canada Founded

Windsor, Ontario for production, not authorship.

1918

GM Canada Established

Oshawa plant. Continental production begins.

1965

Canada-US Auto Pact

Eliminated tariffs on vehicles and parts. Efficiency gained. Ownership permanently lost.

"The Auto Pact integrated two nations into one continental production system. Canada executed. It did not author."

The Auto Pact set the template. NAFTA and USMCA deepened it. Each agreement made Canada more efficient and less sovereign.



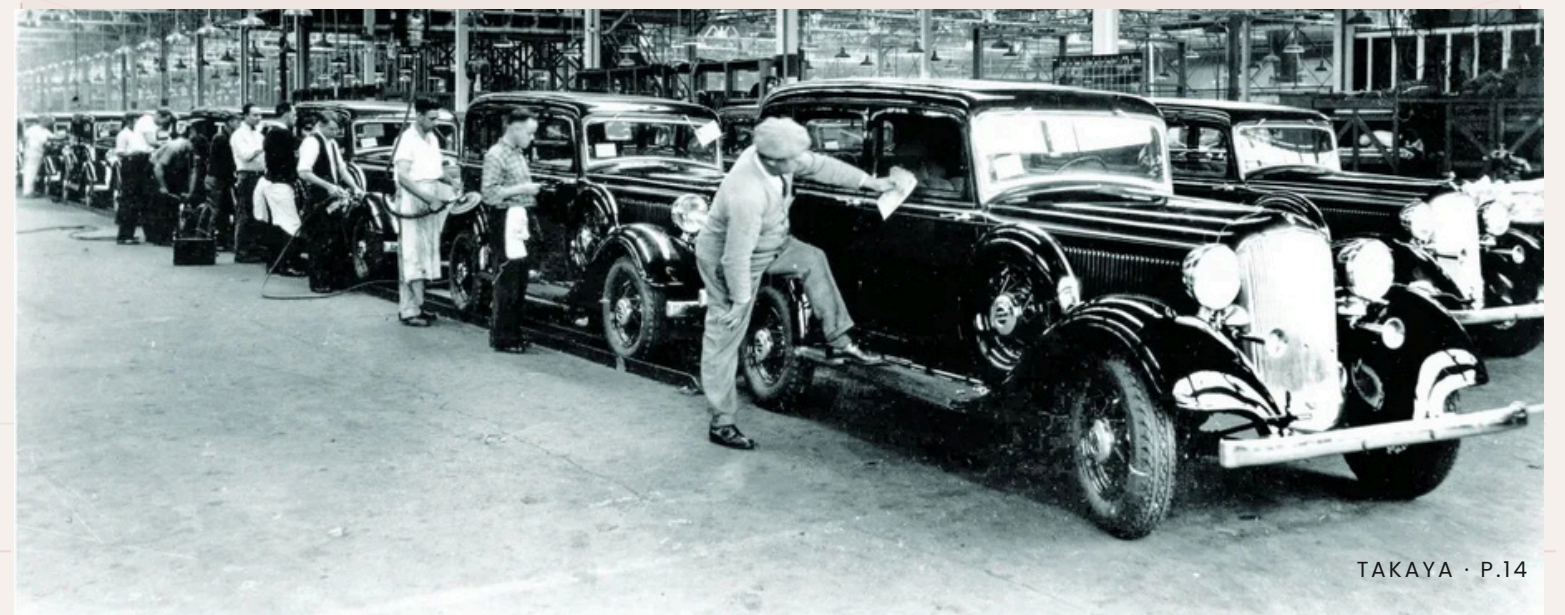
WHAT CANADA GAINED VS WHAT IT LOST

What Canada Gained

- ✓ Skilled manufacturing workforce
- ✓ World-class assembly plants
- ✓ Stable employment in Ontario
- ✓ Continental supply chain access
- ✓ Precision engineering expertise

What Canada Lost

- ✗ Design authorship
- ✗ Brand ownership
- ✗ IP control
- ✗ Product strategy
- ✗ National automotive identity



1994

AUTO PACT ERA ENDS

NAFTA

North American Free Trade Agreement
Expanded the continental production network to include Mexico. Canada specialised in advanced manufacturing and precision engineering. Mexico absorbed high-volume assembly.

OUTCOMES FOR CANADA

- Magna, Linamar, Multimatic grow
- Precision component exports rise
- Design leadership stays US-owned
- IP remains foreign-controlled



2020

NAFTA REPLACED

USMCA

United States Mexico Canada Agreement
Stricter regional content requirements. Higher wage thresholds. Repositioned Canada as a strategic node for EV and advanced materials. First time conditions pointed toward Canadian authorship.

OUTCOMES FOR CANADA

- EV battery rules favour Canadian lithium
- Supply chain disruptions expose foreign dependence
- Reshoring pressure from US tariff policy
- Canada's IP gap becomes more visible



NOW

THE WINDOW OPENS

The Window

Why now is the right moment

Tariff pressures, reshoring mandates, and EV transition create the first genuine opportunity for Canada to own a domestic automotive platform. The structural conditions have shifted.

THE OPPORTUNITY

- \$40B already invested in foreign OEMs
- 92% export dependence exposed
- Sovereignty pressure accelerating

ATTEMPT 01

Bricklin SV-1

New Brunswick · 1974 – 1976

WHAT IT WAS

Malcolm Bricklin, a US entrepreneur, partnered with the New Brunswick government to build a gull-wing sports car in Canada. The province invested \$23M+ in government funding. 2,854 units were produced.

The company collapsed in 1976. Canada was left with no IP, no brand, and no commercial path forward.

KEY FACTS

\$23M+

Government investment
CAD – all lost

2,854

Target was 10,000/yr

Zero

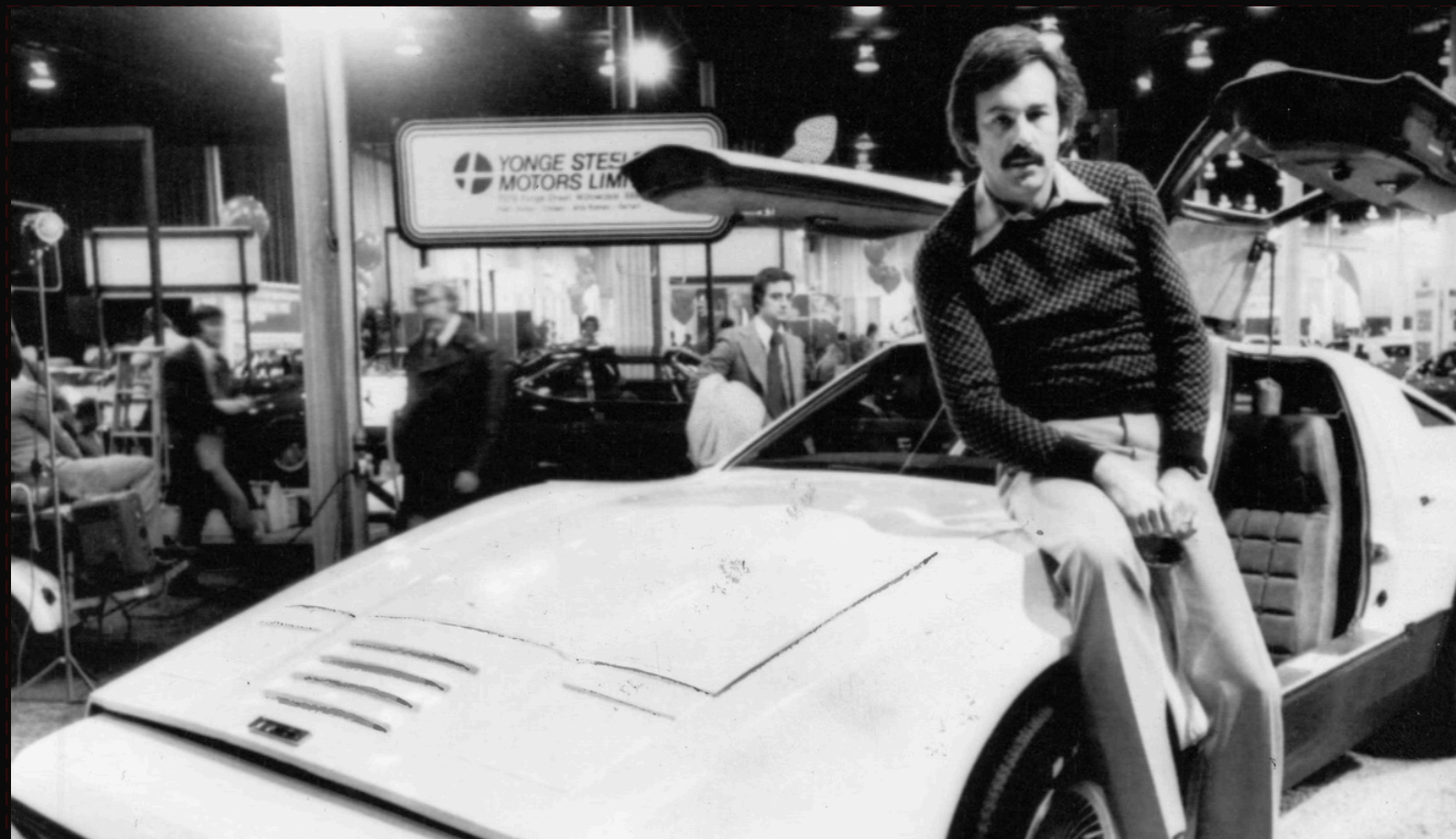
No lasting legacy

WHY IT FAILED

- Wrong model: mass manufacturing in a market too small to sustain it
- Government subsidized the losses instead of the IP
- No supplier ecosystem built around it isolated, not integrated
- Personal venture, not a national system collapsed with the company, No software layer, no platform, no route to scale

Verdict: Wrong model.

Capital-intensive manufacturing for a market too small to justify it. No IP. No legacy.



WHAT IT PROVED AND WHAT IT DIDN'T

Proved:

Canada has the workforce and manufacturing capacity to produce a performance vehicle from scratch

Did not prove:

That mass manufacturing is the right model for Canada.
That a single entrepreneur can carry the structural weight of what should be a national system

Bricklin Showed Canada could build a car

It confirmed that traditional OEM model was the wrong entry point

That lesson took 50 years to build on Takaya builds on it

ATTEMPT 02

Project Arrow

APMA · Canada-wide · 2022

WHAT IT WAS

The Automotive Parts Manufacturers' Association (APMA) coordinated over 60 Canadian suppliers to build a fully electric concept vehicle the first all-Canadian zero-emission vehicle. 97% of its components **were made in Canada. It proved the ecosystem could collaborate.** It produced no IP, no commercial path, and no sustained brand.

KEY FACTS

\$8M

Public investment
Prototype only

60+

Canadian suppliers
Temporary collaboration

97%

Zero commercially licensed

WHY IT STALLED

- Built as a prototype: no production model, no supply chain commitment
- No IP ownership structure: technology stayed with individual suppliers
- No brand created : collaboration dissolved after the showcase
- No commercial vehicle license, no production-ready platform defined
- Proved capability, but not the system needed to sustain it

Verdict: Right capability. Wrong structure.

Arrow proved Canada can build. It left no commercial path, no owned IP, no legacy.



WHAT ARROW GOT RIGHT

- ✓ Demonstrated that 60+ Canadian suppliers can collaborate on one vehicle
- ✓ 97% Canadian-made content — the ecosystem was ready
- ✓ Public and industry reaction confirmed appetite for a Canadian automotive identity
- ✓ APMA now building Project Arrow 2.0 — expanding to production readiness
- **Arrow proved the parts exist. Takaya proves the system exists.**

THE GAP ARROW LEFT — WHAT TAKAYA FILLS

Arrow had no:

- X Production license or commercial model
- X Retained IP — technology stayed with suppliers
- X Brand or market identity
- X Self-sustaining business model

Takaya has:

- ✓ Virtual OEM production model · 20–30 units/yr
- ✓ 9 proprietary software systems owned permanently
- ✓ Canadian brand · export-first strategy
- ✓ \$60M–\$150M+ revenue path at maturity

"Arrow allows Canadian suppliers to tell their story to the world."

— APMA Project Arrow 2.0 Briefing (2024)

Three Attempts. One Structural Truth.

Canada tried to build a cars before. Both times the model didnt succeed. Takaya solves the structure.

DIMENSION	BRICKLIN SV-1 1974	PROJECT ARROW 2022	TAKAYA 2024
YEAR	1974	2022	2024
MODEL TYPE	Traditional OEM	Government prototype	Virtual OEM
CAPITAL	\$23M+ government	~\$8M public investment	\$12.5M – \$25M
IP OWNED	None collapsed	None retained	9 systems · permanent
SUPPLIERS	Isolated manufacturing	60+ temporary collab.	12 crate ecosystem
PRODUCTION	~2,854 units · failed	Single prototype	20–30/yr · pre-sold
SOFTWARE	None	None	9 proprietary systems
SCALABILITY	Failed under cost	Not designed to scale	Expands by design
BRAND	Personal venture	APMA consortium	Canadian-owned platform
OUTCOME	Bankrupt 1976	Capability, no legacy	Self-sustaining system

Wrong model
Capital-intensive · no IP · bankrupt

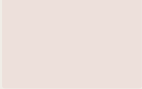

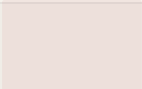


Right capability. Wrong structure.
Proved it can be done · no legacy created

Right model for Canada.
Virtual OEM · owned IP · scalable platform

Canada Builds

the World's Best Cars.

Not one of them carries a Canadian badge.

VEHICLE	BRAND	CANADIAN CONTRIBUTION	COMPANY	LOCATION
 Ford GT	Ford (USA)	Full vehicle engineering, chassis + assembly	Multimatic	Toronto, ON
 Aston Martin Valkyrie	Aston Martin (UK)	Carbon fibre structural monocoque tub	Multimatic	Toronto, ON
 Rivian R1T / R1S	Rivian (USA)	Contract manufacturing, full vehicle assembly	Magna	Aurora, ON
 Lucid Air	Lucid (USA)	Vehicle assembly, body manufacturing	Magna	Aurora, ON
 BMW X3 / X4 Drivetrains	BMW (Germany)	Powertrain components, precision machining	Linamar	Guelph, ON

Canada Invests Heavily. Not in Its Own Story.

Canada invested \$40 billion in foreign OEM subsidies between 2021 and 2024.

In the same period, it spent approximately \$8 million on Project Arrow its only serious attempt at a domestic automotive prototype. No commercial path was defined for it.

INVESTMENT COMPARISON — 2021 TO 2024

Foreign OEM Subsidies

\$40 BILLION CAD

Battery factories: Stellantis, VW, GM, Honda

Canadian-Led Automotive R&D

\$900M

SIF/ASIP clean-tech programs

Project Arrow

\$8M — one prototype · zero commercial rollout

Scale: each 1cm = approximately \$290M CAD. Project Arrow bar is not visible at this scale.

The takeaway:

Canada prioritizes industrial output and foreign partnerships over innovation leadership, IP ownership, or national identity. The funding model has never rewarded authorship.

Takaya proposes a model where a fraction of that investment builds something Canada owns.

"Canada must be more than a branch-plant economy; we need to create and own technology that the world depends on."

— François-Philippe Champagne, Minister of Innovation (2024)

FULL DATA TABLE

RECIPIENT	AMOUNT (CAD)
Foreign OEMs	\$40,000,000,000
Canadian-Led R&D	\$900,000,000
Project Arrow (prototype)	\$8,000,000
Vehicle Export Rate	92%
Domestic vehicle sales	0.19M units
Canadian-owned OEM brands Auto sector GDP contribution	Zero \$16 billion / yr

\$40B foreign vs \$8M domestic
A 5,000x investment imbalance.

As I continued researching, I found that Canada had made several attempts in the past many of them ambitious, but often limited to prototypes or short-lived ventures. Around the same time, shifts in trade and tariff discussions highlighted how dependent Canada's automotive sector remains on external systems, particularly the United States. This made the question more urgent: the issue was not just absence, but vulnerability.

Mussawer Ahmed

LANDSCAPE + 04

87.2%

of all vehicles produced in Canada are exported.
Most under foreign brands. None Canadian-owned.



THE STRUCTURAL PARADOX

The sector contributes over \$16B to GDP, employs 600,000+ people, and produces 1.29M vehicles annually. Yet Canada has never developed its own national car brand. Over 90% of vehicles are exported, and the majority of public investment supports foreign-owned automakers, not domestic design leadership.

Canada excels in execution. It has never been the author.

The infrastructure exists. The coordination layer does not. That is what Takaya provides.

What does this mean?

Canada excels in execution and supply chain delivery. It lacks a platform to convert that capability in to cultural **authorship or long-term economic value.**

THE MISSING ELEMENT

Canada needs a design-led, collaborative model that allows it to express and export its own **innovation identity— not just manufacture someone else's.**

FIVE KEY FINDINGS FROM THIS CHAPTER

- 01 The Auto Pact (1965) locked Canada as manufacturer, not author.**
Six decades later, every trade agreement deepened that role without changing the ownership structure.
- 02 Canada builds Aston Martins, Ford GTs, and Rivians on Canadian soil.**
Not one carries a Canadian badge. The engineering exists entirely with in someone else's story.
- 03 Canada invested \$40B in foreign OEMs and \$8M in its own prototype.**
Project Arrow proved the capability. It did not produce a commercial path, an IP asset, or a brand.
- 04 Four structural barriers block every path toward a Canadian OEM.**
Capital intensity, supplier conflict, market scale, and absence of a coordination layer. All four must be solved together.
- 05 The infrastructure exists. The coordination layer does not.**
700+ suppliers, advanced R&D institutions, government programs, and motorsport culture all exist in Canada. What has never existed is a unified platform above them

WHAT THIS POINTS TO

Canada doesn't need to build more factories.
It needstobuildaframeworkforcollaboration, identity, and authorship.

A design-led project can bridge the divide between innovation policy and industrial storytelling. Not a government prototype. Not a traditional OEM. A Virtual OEM — a coordination platform that activates what already exists, generates owned IP, and gives Canada a name on the badge.

That is Takaya.

The following chapters show how the system is structured, how the car proves it, and how the IP compounds.

NEXT: CHAPTER 05 — IDENTIFYING THE OPPORTUNITY

Structural realization · 70/30 gap · Global parallels · Design-led entry point



IDENTIFYING THE OPPORTUNITY

The Structural Realization

The research did not begin with a solution.
It began with a contradiction I could not resolve.

Canada builds Aston Martins. It builds Ford GTs. It assembles vehicles for major global brands with extraordinary precision. Not one of those vehicles carries a Canadian name.

My initial assumption was that this was a funding problem.
Then I thought it was a policy problem. Then a market-size problem.

Each time I mapped the barriers, they traced back to one root cause: the absence of a coordination layer above the suppliers.

The moment thinking shifted:

Canada does not lack the parts. It lacks the platform that organizes the parts into a coherent system it can call its own. That platform has never existed.

Designing that platform became the project.

THE THREE QUESTIONS THAT DROVE THE RESEARCH

- 01 · Why has Canada — with all its manufacturing strength — never produced a national car brand?
- 02 · What structural conditions would need to change for that to become possible?
- 03 · What role can an industrial designer play in answering that — not just as a stylist, but as a system architect?

The answer to all three questions is the same:

Build the coordination layer. Call it Takaya.

CHAPTER 05 — THIS CHAPTER

P.21 The Structural Realization

You are here. The moment the thinking shifted.

P.22 Limits of Mass Manufacturing

Three barriers: capital, market scale, global competition.

P.23 Strength in Subsystems — 70/30 Gap

What Canada already has. What's missing. Why it matters.

P.24 The Missing 30% is a Roadmap

Each gap is an IP opportunity. Short/mid/long-term pathway.

P.25 Global Parallels

Rimac, Koenigsegg, Pagani, Czinger — small team, owned IP.

P.26 Design-Led Entry Point

Why design is the right starting layer, not engineering or government.

THE SHIFT IN THINKING

BEFORE

"Canada needs more funding"
"Canada needs better policy"
"Canada needs to grow its market"
"Canada needs to copy an OEM"

All symptom-level thinking.

AFTER

"Canada needs a platform"
A coordination layer above the suppliers that organizes existing capability into a unified, Canadian-owned system.

That is the structural insight.

"The problem was never the car.

It was the system behind it."

— Mussawer Ahmed, Designer's Statement

Mass Manufacturing **is the Wrong Model.**

Canada can no twin on volume. Germany, Japan, South Korea, and China have decades of scale, established distribution, and brand loyalty that cannot be matched from zero. Three structural barriers make mass manufacturing the wrong entry point for Canada.

01 Capital Intensity

A traditional OEM launch requires \$1.5B–\$2B minimum before the first vehicle reaches a customer. Factory tooling, regulatory certification, dealer networks, and brand-building all precede any revenue.

\$1.5B+

before first unit sold

Takaya entry cost:
\$12.5M–\$25M

60× lower than traditional
OEM No factory required

→ Virtual OEM removes this barrier

02

Canada sells 0.19M vehicles annually domestically. Mass production requires 50,000–200,000 units per year to be economically viable. Canada's domestic market cannot absorb that volume for a new, untested brand.

0.19M

domestic vehicles sold/yr

Takaya production target:
20–30 units / year

Export-first · pre-sold before production No
unsold inventory risk

→ Hypercar model removes this barrier

03 Global Competition

Mass market entry means competing against Toyota, Volkswagen, Hyundai, and Stellantis all with 50+ years of brand equity, global supply chains, and subsidized platforms. Canada cannot win a volume war from zero.

50+ yrs

of competitor brand equity

Takaya competes on:
Exclusivity + IP

Not volume — value per unit
Software + crate licensing

→ Software IP removes this barrier

Canada cannot win on volume, cost, or brand legacy. Canada wins on integration, software, and precision —
exactly what the Virtual OEM model produces.

70%

of a hypercar **already**
producibile in Canada.

WHAT CANADA ALREADY HAS — 70%



KEY CANADIAN SUPPLIERS CONTRIBUTING TO THESE SYSTEMS

Multimatic (monocoque, suspension, assembly) · Magna (body, thermal, electronics)
 Linamar (powertrain, gearbox) · Martinrea (chassis, body) · Dana TM4 (electric motors)

OVERALL CANADIAN CAPABILITY

70% — CANADA CAN PRODUCE

30% GAP

Canada is not starting from zero. It is starting from 70%.

No other small-nation automotive program has this foundation.

WHAT'S MISSING — THE 30%

Complete ICE Engine (V10/V12)

Canada has no domestic high-performance engine manufacturer.

0% PRODUCED IN CANADA · PARTNER-SOURCED · IP ROADMAP ITEM

Carbon Ceramic Brake Discs

High-temp ceramic compound manufacturing not yet established in Canada.

0% PRODUCED IN CANADA · IMPORT · MID-TERM IP TARGET

Performance Tires

No Canadian performance tire compound manufacturer at this specification.

0% PRODUCED IN CANADA · PARTNER-SOURCED

VCU Full Software Stack

Vehicle Control Unit full-stack development. Canada is at 0-10% currently.

0-10% · HIGHEST PRIORITY IP TARGET · \$10-40M+ LICENSING VALUE

High-Discharge Battery Cells

Cell chemistry manufacturing at performance spec requires new Canadian facility.

20% CURRENTLY · LONG-TERM BUILD TARGET

The 30% gap is not a weakness.

It is the IP roadmap. Every missing capability is a development target that, once achieved, becomes a licensable asset owned **permanently by Takaya and deployable to any OEM globally.**

The Missing 30% Is the Roadmap.

Every gap in Canada's current capability is a target. Reaching each target creates an asset.
That asset is owned by Takaya. It can then be licensed to any OEM in the world.

SHORT TERM Year 1-2

LICENSE EXISTING CANADIAN IP

Damper + suspension tech

Multimatic DSSV dampers — already the global standard for performance vehicles. License from day one.

Composite + carbon fibre

Multimatic carbon monocoque. Already proven on Valkyrie + GT. Integrate directly into Takaya.

Electric motor tech (Dana TM4)

Dana TM4 in Boucherville, QC. Proven e-motor and inverter systems. Direct crate integration.

Basic VCU foundation

Build initial VCU framework from partner-sourced base. Begin Takaya software development internally.

MID TERM Year 3-5

CO-DEVELOP WITH PARTNERS

Battery management system

Co-develop NMC/NCA thermal management with Ontario Tech.
Own the algorithm, not the cell.

Full torque vectoring stack

Per-wheel powersplit algorithm developed through hypercar testing. First licensable Takaya IP asset.

Brake-by-wire control system

Regenerative + mechanical blending algorithm. Safety-critical, ASIL-D. High licensing value: \$2-10M/deal.

Thermal + active aero systems

Extreme temperature testing in Canadian climate conditions — unique differentiator no other OEM can claim.

LONG TERM Year 6-10

Ongoing

OWN THE FULL STACK

Full VCU stack — owned

Complete vehicle brain from Takaya internal development. License: \$10-40M+ per OEM deal.

ISO 26262 functional safety

ASIL-D certified safety monitor. Every OEM needs this. Takaya owns and licenses it globally.

Predictive torque management

AI-driven anticipatory control. Built from hypercar telemetry data accumulated over years of use.

Platform expansion IP

Defence · fleet · transit sectors. Thermal + VCU transfer into unmanned ground vehicles.

Hardware depreciates. Software compounds.

Each cycle of the hypercar generates data that improves the software. *The IP gets more valuable with every unit sold.*

Global Parallels.

Small teams OwnedIP. Global brands.Canada can do this.

COMPANY	COUNTRY	MODEL	PROGRAM COST	PRICE	KEY ADVANTAGE
Rimac <small>Most direct model for Takaya to follow</small>	Croatia	Virtual OEM + IP licensing	\$27M-\$30M	\$3M USD	Software licensing to Porsche, Bugatti, Hyundai
Koenigsegg	Sweden	Small team, supplier integration	\$18M-\$26M	\$3M USD	Proprietary freevalve engine, carbon tech
Pagani	Italy	AMG engine + owned carbon IP	\$15M-\$22M	\$2.5-3.5M USD	Carbotitanium monocoque, artisanal identity
Czi nger	USA	AI + additive manufacturing platform	\$20M-\$30M	\$2M+ USD	3D-printed titanium chassis, AI design IP
Singer	USA/UK	Restoration + design platform	\$10M-\$18M	\$1.8-2.5M USD	Brand as design authority, bespoke identity
TAKAYA	Canada	Virtual OEM · crate ecosystem	\$12.5M-\$25M	\$1.5-2.2M CAD	9 software systems + Canadian IP platform

WHAT EVERY COMPANY IN THIS LIST HAS IN COMMON

Small team	Owned IP	Pre-sold production	Export-first
None employ more than 400 people. Integration over vertical manufacturing. World-class suppliers build the parts.	Every company owns a core technology no one else controls — carbon, software, manufacturing process, or design DNA.	Units are sold before production begins. Zero inventory risk. Waitlists of 2-5 years.	None rely on their home market. Croatia, Sweden, Italy — all selling globally from small domestic bases.

Croatia built Rimac. Sweden built Koenigsegg. Italy built Pagani.

Canada — with 70% of the hypercar already in its supply chain — can build Takaya.

The precedent is not just possible. It is proven — by every company in this table.

Why Design Is the Right Entry Point.

Government enters through policy. Engineering enters through specification. Both approaches have been tried. Neither produced a sustained Canadian brand. **Design enters through the whole system and that is what this project required.**

Government-Led	Engineering-Led	Design-Led
<p>Bricklin: government funded, government lost. Project Arrow: government prototype, no commercial exit. \$40B invested in foreign OEMs. Policy creates the conditions. It does not make the product or own the IP.</p> <p>CREATES CONDITIONS Cannot build the system or own the brand</p> <p>✗ Not sufficient alone</p>	<p>Suppliers like Magna and Multimatic have world-class engineering. Each specializes in one system. None can see the whole vehicle. Building a complete car would conflict with their OEM relationships.</p> <p>BUILDS THE PARTS Cannot coordinate the whole system</p> <p>✗ Not sufficient alone</p>	<p>Design understands the whole system. It maps the user, the structure, the stakeholders, and the physical outcome. Design translates between engineering, business, and national identity in one act.</p> <p>SEES + BUILDS THE SYSTEM Integrates capability, brand, and strategy</p> <p>✓ The right entry point</p>

The designer's role in this project:

Not to engineer every component. Not to write every policy. Not to fund every supplier. To design the coordination architecture — the system that makes all of those things possible.

Industrial designer as system architect. That is this project.

HOW DESIGN CONNECTS EVERYTHING

MACRO — Government, Investors, Suppliers

Design maps the incentives and aligns them into a coherent brief.



MESO — 12 Modular Subsystems

Design specifies how each crate connects and what it must deliver.



MICRO — The Hypercar

Design is the physical output — the proof that the system works.

WHAT THIS DESIGNER DID AT EACH LAYER

- Macro: Mapped stakeholder incentives. Identified the structural gap. Framed the brief.
- Meso: Defined 12 subsystem crates. Specified Canadian sourcing. Mapped the IP gaps.
- Micro: Designed the vehicle architecture. Built the prototype. Created the identity.

THE EXPANDED ROLE OF INDUSTRIAL DESIGN

Industrial design is often described as the discipline that gives form to function. That definition is incomplete. In this project, design gave form to the system that makes function possible. The car is not the design output. The ecosystem is. The car is the proof of the ecosystem.

Government cannot do this, it funds, not builds. Engineering cannot do this —, it executes, not coordinates.

Design does this it synthesizes, proposes, and makes the whole visible.

Not decoration. Not styling. Strategy made physical.

That is what Takaya proves about the role of the industrial designer. End of Chapter 05. Chapter 06 begins the hypercar as business strategy.

HYPERCAR AS HALO

Why a Hypercar?

The hypercar is not the destination. It is the entry point. Validates all 12 subsystems under extreme conditions, generates

9 proprietary software systems, and builds a global brand identity.

SIX STRATEGIC REASONS

Low capital entry

No factory required. \$12.5M-\$25M program cost. 60x lower than a traditional OEM launch.

No mass market needed

20-30 units per year. Pre-sold before production. Zero inventory risk. Export-first strategy.

Validates all 12 crates

Every subsystem proven under hypercar load. Pitch, roll, yaw, thermal, regen at the limit.

Generates owned IP

Each drive cycle refines the software. 9 control systems compound in value every unit delivered.

No supplier conflict

Low volume does not compete with OEM clients. Magna, Multimatic, Linamar keep all contracts.

Builds global brand

A hypercar earns attention and cultural weight no policy program or prototype ever could.



CHAPTER 06 COVERS

P.27 Why a Hypercar ; you are here

P.28 Halo Project Logic ; Ferrari, Rimac, Koenigsegg

P.29 Business Model ; two revenue lines

P.30 Unit Economics : cost, price, margin per unit

P.31 Program Cost Benchmarking : vs Rimac and Valkyrie

P.32 Self-Sustaining Business Loop

P.33 Platform Expansion Roadmap

Halo Project Logic.

Identity first. Scale later. Every great automotive brand started this way.

A halo product earns brand credibility far beyond its production volume. It sets the performance benchmark, defines the design language, and attracts talent, press, and partners no budget alone reaches.

Ferrari **LaFerrari 499 units**

Validated Ferrari hybrid tech for the entire range. Defined the brand for a decade.

Rimac **Nevera 150 units at \$3M USD each**

Software IP licensed to Porsche, Bugatti, Hyundai. Licensing revenue exceeds car sales.

Koenigsegg **Jesko 125 units**

Free valve engine tech developed through the halo. R+D funded by the car, deployed across the brand.

Pagani **Zonda and Huayra, each generation**

Redefined Italian performance identity. Small volume, global recognition. Artisanal IP.

TAKAYA **Hypercar 20 to 30 units**

Validates 12 subsystems. 9 software systems owned permanently. Canadian identity established globally.

This is the Takaya entry strategy, proven by every brand in this list.

None of these brands started with mass-market. All started with a halo that proved the system, **defined the identity, and unlocked every commercial opportunity that followed. Takaya is no different.**

Business Model.

Two revenue lines. One ecosystem. Permanently Canadian-owned.

Hardware Revenue

Physical products and services

Hypercar sales **\$24M-\$60M / yr**
20-30 units per year, pre-sold

Crate module sales **\$150K-\$400K / unit**
Individual subsystems to partners

Defence hardware **\$2M-\$8M / contract**
Government and military contracts

After-sales + OTA **\$20K-\$60K / unit / yr**
Software updates and servicing

\$24M-\$60M

HARDWARE REVENUE PER YEAR

Software IP Revenue

Licensing and royalties

Full platform deal **\$10M-\$40M+ / deal**
Complete system licence to one OEM

VCU + torque vectoring **\$2M-\$8M / deal**
Core control stack licence

ISO 26262 safety monitor **\$2M-\$10M / deal**
Functional safety stack

Thermal + battery algorithms **\$500K-\$6M / deal**
Environmental management IP

\$10M-\$40M+

Combined revenue at maturity (hardware + software):

\$60M-\$150M+ CAD per year

Unit Economics.

Per vehicle. Every vehicle. The margin that makes the platform self-sustaining.

TAKAYA -- PER UNIT ECONOMICS



40-65%

\$24M-\$60M

hardware revenue per year (20-30 units)

Vehicle sale margin: \$600K-\$1.4M per unit

After-sales and OTA updates: \$20K-\$60K per unit per year

Telemetry data: compounds all 9 software systems

IP value: grows with every drive cycle delivered

The hypercar is self-funding.

Hardware revenue at 20-30 units funds the software IP development.

The IP earns additional licensing revenue. The model compounds without external funding.

PRICE BENCHMARKING vs COMPETITORS

Takaya Canada	\$1.5M-\$2.2M CAD
Rimac Nevera Croatia	\$3M USD
Koenigsegg Jesko Sweden	\$3M USD
Aston Martin Valkyrie UK	\$4M USD
Red Bull RB17 Austria	\$5M+ USD
Pagani Huayra Italy	\$2.5M-\$3.5M USD

Takaya enters at the most accessible price point in this category

while offering Canadian provenance and cold-weather validation

no competitor can claim. Exclusivity, not volume.

Program Cost Benchmarking.

Takaya enters at half the cost of its nearest comparable competitor.

HYPERCAR PROGRAM COSTS -- LAUNCH TO FIRST PRODUCTION UNIT

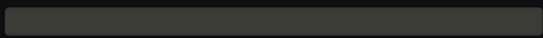
Takaya

Virtual OEM no factory required

 \$12.5M-\$25M

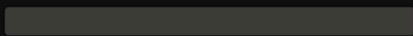
Rimac Nevera

Croatia EV hypercar platform

 \$27M - \$30M

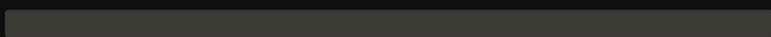
Koenigsegg Jesko

Sweden small team integration

 \$18M - \$26M

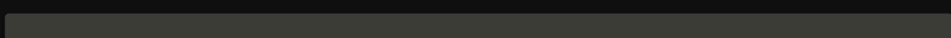
Aston Martin Valkyrie

UK -;F1 partnership + Multimatic

 \$40M +

Red Bull RB17

Austria F1 derived road car

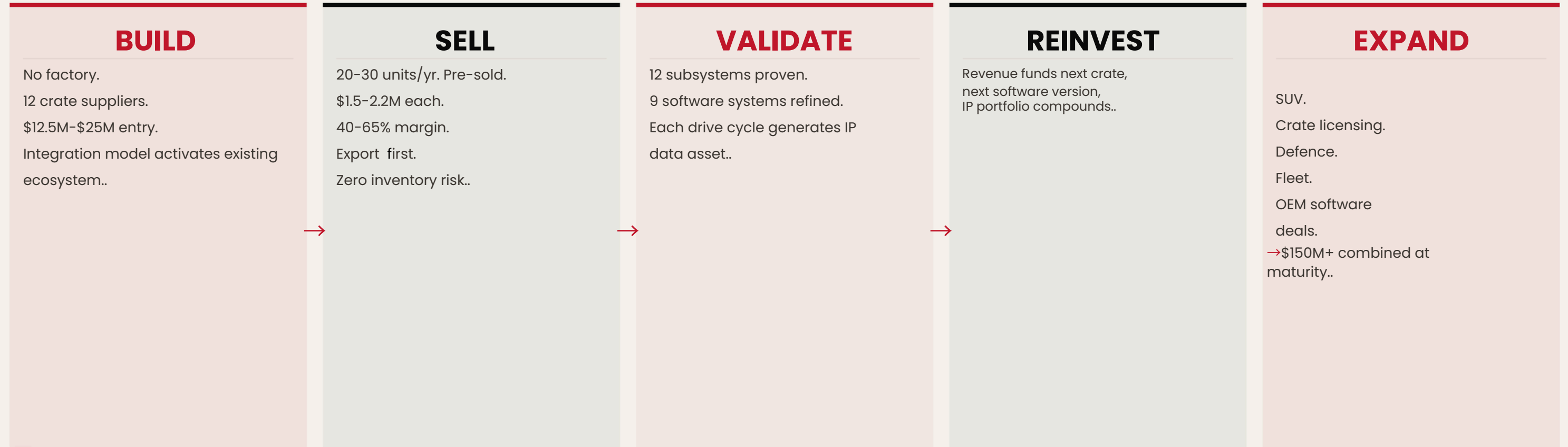
 \$50M +

\$12.5M-\$25M vs \$1.5B+ for a traditional OEM.

The Virtua IOEM model achieves hyper car development at 60x lower entry cost than a traditional OEM launch.

Self-Sustaining Business Loop.

Each stage feeds the next. The IP compounds. The platform grows.

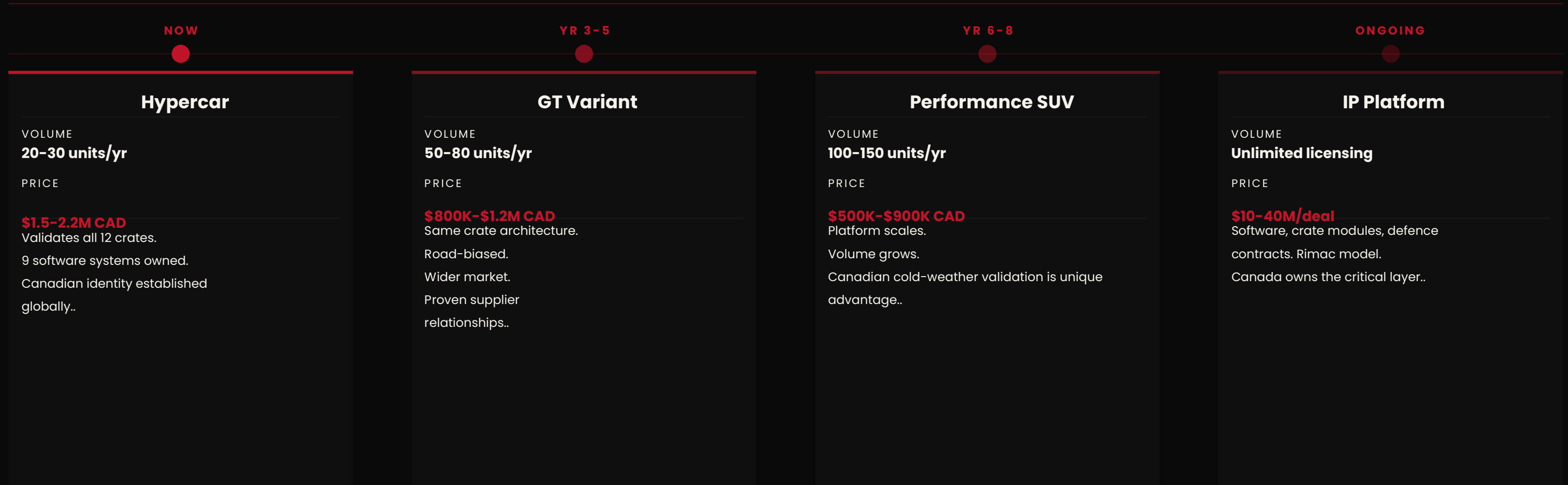


SELF-SUSTAINING LOOP -- IP COMPOUNDS EVERY CYCLE

Canada does not need to outsell Toyota. It needs to own the layer that generates the highest margin per unit. **The hypercar is not the business. It is the proof of the business.**

Platform Expansion Roadmap.

The hypercar opens the door. The platform walks through it.



WHY THIS SEQUENCE WORKS

Each stage reuses the crate architecture from the previous. Supplier relationships deepen. IP compounds.

Volume grows without factory investment. The brand earns authority at each level before moving to the next.

End of Chapter 06. Chapter 07 maps the stakeholders who make this possible.

At this point the question became: how can a Canadian automotive company exist within today's constraints? Traditional OEM models require massive upfront investment and conflict with existing supplier relationships. This led to the idea of a different structure one that works with the system rather than against it.

Mussawer Ahmed

Canada has the parts. The talent. The factories. The system is what is missing.

Canada produces some of the most advanced automotive components in the world.

Carbonmonocoques from Multimatic. Hybrid drive systems from Magna. E-motors from TM4. Powertrain components from Linamar. Structural engineering from Martinrea. Each company excels at its niche. None assemble complete vehicles.

They supply the world's best brands instead of building Canadian ones.

This fragmentation is not just an economic problem. It is a design problem.

Without a system that connects suppliers, engineers, universities, and government, Canada cannot develop vehicles that express national identity, innovation, or IP ownership. Takaya exists to solve this structural gap: to design the missing ecosystem that unifies *Canadian components into a single, coherent performance platform.*

WHAT THIS CHAPTER MAPS

Why suppliers alone cannot build a brand

Canada's extreme specialization created fragmented excellence. Each supplier masters one domain. No platform exists above them.

Why government investment has not produced authorship

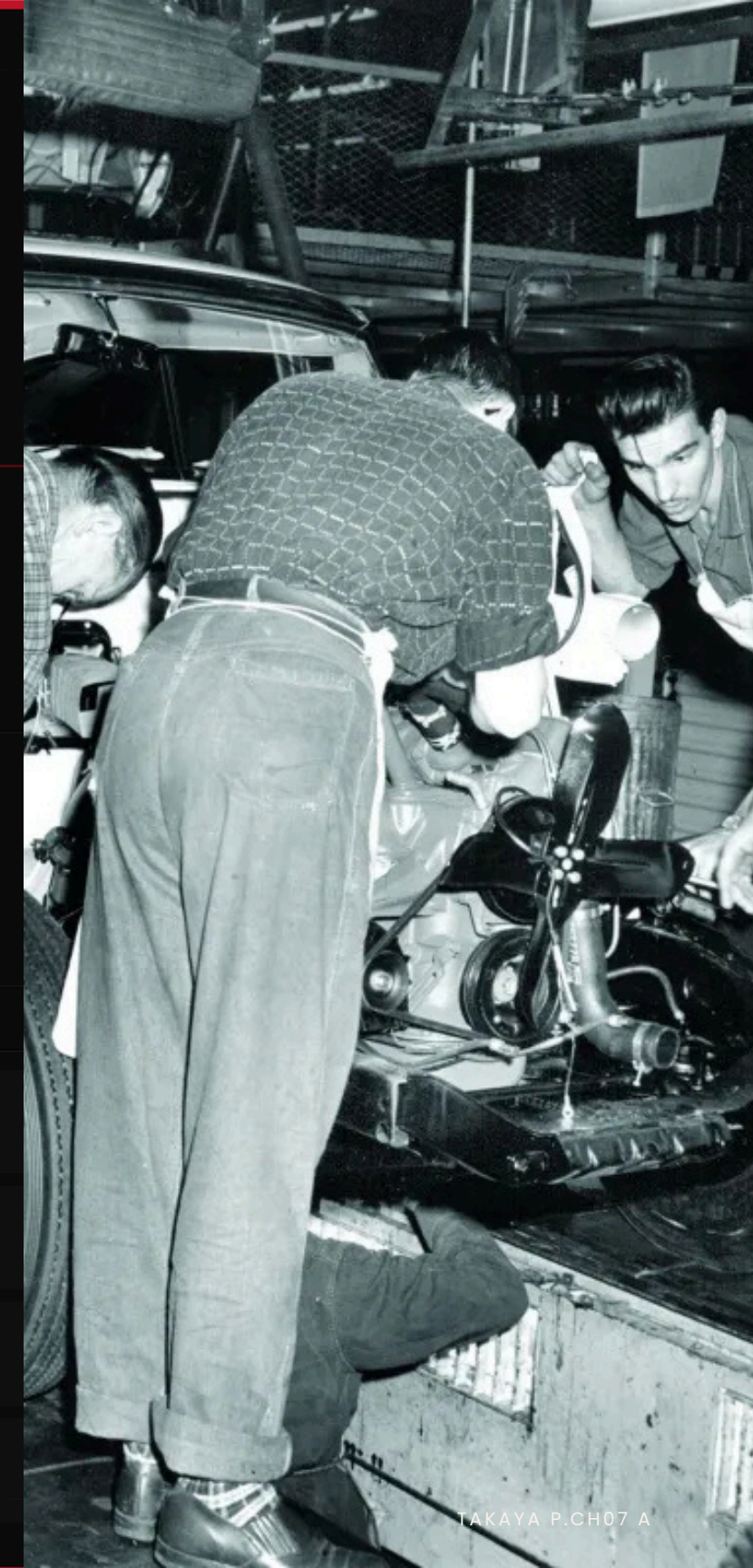
Agencies like ISED, OVIN, NRC-IRAP, and SIF actively support Canadian automotive IP but no single vehicle platform has unified them.

Why investors see this as a technology platform, not just a car

Software, torque vectoring logic, and aero control systems can be licensed globally. Margins are high. Scalability is built in.

Why the timing is structural, not coincidental

US-China tariffs, USMCA content rules, reshoring pressure, and EV transition policy all converge in 2024-25 to create a once-in-a-generation opening.



Stakeholder Research.

The ecosystem is designed for multiple end-users. Not just drivers.

7

The ecosystem serves Canadian suppliers who gain a unified innovation platform, government agencies that support R+D and national IP growth, investors seeking high-margin technology opportunities, engineers and students who engage with crate modules, and drivers and enthusiasts whose real-time telemetry feeds back into performance refinement. The ecosystem functions as a living system, not a static design.

WHAT THE MAPPING REVEALED

Suppliers are ready, but uncoordinated

Canada's suppliers evolved into global specialists. Multimatic on chassis. Magna on drives. TM4 on motors. Each a master in one domain. None collaborate under a shared vehicle architecture.

Government funding exists, but lacks a vehicle

OVIN, NRC-IRAP, SIF, and federal EV mandates actively support Canadian automotive IP. What has been missing is a single platform worthy of coordinating that support.

Investors want a technology platform, not just a car

Car companies are high-capex, low-margin, risky investments. Software, control units, and IP licensing are scalable, exportable, high-margin, and defensible.

Canadians want a flag to drive under

Tariffs and geopolitical instability reignited the question: why does Canada not build its own cars? Public sentiment increasingly supports domestic innovation. The appetite exists.

The timing is structural, not coincidental

USMCA's 75% North American content rules, EV battery sourcing requirements, and reshoring pressure all converge. For the first time in history, policy encourages Canadian-designed vehicles.

CHAPTER 07 COVERS

P.34 Stakeholder Research -- you are here

P.35 8 Stakeholder Groups -- full map

P.36 Why Suppliers Care

P.37 Why Government Cares

P.38 Why Investors Care

P.39 Why Now -- the timing window

P.40 Aligned Incentives Summary

"We don't have a car company, yet we're the world's 12th largest automaker producing other people's cars. Canada is left hanging in the wind." Flavio Volpe

This quote defines the unmet need that every stakeholder group shares. Each group experiences it differently. Takaya addresses all of them at once.

8 Stakeholder Groups.

GROUP	KEY MEMBERS	UNMET NEED	WHAT TAKAYA GIVES THEM
Tier 1 Suppliers No. 1	Magna, Multimatic, Linamar, Martinrea, Dana TM4	World-class parts. No coordinated Canadian platform above them.	IP authorship, brand visibility, no OEM conflict
Canadian Engineers No. 2	Fabricators, R+D teams, precision specialists	Follow someone else's blueprint. No Canadian vehicle to design.	A Canadian architecture to build toward
Auto Designers No. 3	Industrial designers, design students, OCAD, Waterloo	No vehicle that reflects Canadian identity or offers a design path.	A national form language and design career trajectory
Government Agencies No. 4	ISED, SDTC, OVIN, NRC, IRAP, Ontario EconDev	Invest billions in foreign OEMs. Need proof of national IP ROI.	A platform that aligns with EV policy and trade sovereignty
Industry Associations No. 5	APMA, CME, automotive councils	Need one symbolic success to unify the ecosystem.	Arrow proved the parts exist. Takaya proves the system exists.
Investors No. 6	BDC, angels, family offices, strategic OEM partners	Fund bold, defensible ideas with software IP and exit paths.	Hardware margins, software licensing, defence and fleet exits
Car Enthusiasts No. 7	Canadian motorsport community, F1 fans, collectors	Cheer for McLaren and Porsche. No Canadian name to cheer for.	The first performance brand built from Canadian identity
General Public No. 8	Citizens, young designers, students, car buyers	No car that feels like it came from here.	A flag to drive under. A proof that Canada authors.

Each group has a different reason. All point to the same gap. Takaya is the first project to address all eight at once.

Why Suppliers Care.

Canada's suppliers evolved to become global specialists.

Multimatic focuses on chassis and composites. Magna builds transmissions, electric drives, and ADAS components. TM4 creates motors and inverters. Linamar and Martinrea produce engine and structural systems.

Each is a master in one domain. They do not collaborate under a unified platform or shared vehicle architecture. Their technologies disappear into **foreign brands, never contributing to a Canadian design identity.**

FOUR OUTCOMES TAKAYA GIVES SUPPLIERS

01 IP Authorship

Each supplier contributes a named crate. That contribution is credited within a Canadian-owned system -- not anonymous production under a foreign NDA. For the first time, a supplier's component carries a Canadian identity.

02 Brand Visibility

The Takaya hypercar carries Canadian supplier names as part of its engineering story. Multimatic carbon. Magna thermal. TM4 motors. This is the first Canadian vehicle designed to make that visible.

03 No OEM Conflict

Low volume -- 20 to 30 units per year -- does not compete with Ford, Aston Martin, or Rivian. Existing OEM contracts remain completely untouched. Takaya is not a competitor. It is a platform that sits above the supply chain.

04 A Platform to Scale With

If Takaya expands to a GT variant or performance SUV, the same crate suppliers scale with it. Long-term partnership built from the hypercar up. The crate model is designed to grow. Every supplier grows with it.

KEY SUPPLIERS IN CRATE ECOSYSTEM

Magna International

Aurora, Ontario

Vehicle assembly, body, thermal, electronics. Assembles Rivian and Lucid. 170,000 employees globally.

Multimatic

Toronto, Ontario

Carbon monocoque, DSSV suspension, full vehicle engineering. Built the Ford GT and Aston Martin Valkyrie monocoque.

Linamar Corporation

Guelph, Ontario

Powertrain components, gearbox, precision machining. Supplies BMW, GM, Ford. 26,000 employees.

Martinrea International

Vaughan, Ontario

Chassis, body structures, fluid systems. Supplies all major OEMs. 15,000 employees.

Dana TM4

Boucherville, Quebec

Electric motors, inverters, e-axle systems. Proven in EV platforms globally. Quebec-based IP.

Why Government Cares.

The US-China tariff war disrupted global supply chains, pushing North America to reduce dependence on foreign parts and rebuild regional manufacturing. USMCA's higher content requirements and battery sourcing rules now favour Canadian suppliers, while reshoring trends make Canada the US's most secure and strategic technology partner. For the first time, trade policy supports Canadian-designed vehicles -- not just Canadian manufacturing.

Global and North American Shift

US-China tariff war pushed North America to reduce dependence on foreign parts and rebuild regional supply. USMCA content rules and battery sourcing requirements now favour Canadian suppliers over offshore alternatives. Reshoring trends make Canada the US's most secure and strategic advanced manufacturing partner.

For the first time, trade policy supports Canadian-designed vehicles.

National Identity and Industry Momentum

Tariffs and geopolitical instability reignited the question: why doesn't Canada build its own cars? Government initiatives OVIN, NRC-IRAP, and federal EV funding actively support Canadian automotive IP. APMA president Flavio Volpe stated Canada has the talent to build complete vehicles. We have simply never claimed it.

Public sentiment and policy are aligned for the first time.

A Once-in-a-Century Opportunity

Europe protects its EV sector. China expands aggressively. Korea and Japan strengthen domestic systems. This creates a historic opening for Canada: world-class suppliers, rising public sentiment, government backing, and economic conditions aligned for national automotive identity building.

Takaya responds by unifying Canadian capabilities into a platform.

GOVERNMENT PROGRAMS ALIGNED WITH TAKAYA

OVIN

Ontario Vehicle Innovation Network, supports Ontario EV and AV development

NRC-IRAP

Industrial Research Assistance Program, funds early-stage Canadian tech

SDTC

Sustainable Development Technology Canada, clean tech and battery programs

SIF

Strategic Innovation Fund, large-scale manufacturing and R+D investment

ISED

Innovation, Science and Economic Development, national IP strategy alignment

Why Investors Care.

This is not investment in a car company. It is investment in a national technology platform.

Car companies are high-capex, low-margin, risky investments. Technology ecosystems software, control units, IP licensing- are scalable, exportable, high-margin, defensible, globally applicable, and produce much faster ROI. Takaya reframes the project from investment in a car company to investment in a national automotive technology platform.

FIVE INVESTOR VALUE CENTRES

01

IP Development

The most valuable asset.

Software, torque vectoring logic, aero control systems all licensable globally. Margins are extremely high. The Rimac model applied to Canada.

02

Crate Architecture Licensing

Modular system licensing.

The crate system can be sold to universities, motorsport teams, engineering schools, EV startups, and specialty OEMs. Revenue beyond the car.

03

Brand and Halo Product Value

High-net-worth collector market.

Limited-run halo products validate engineering capability, performance credibility, and market demand. This is how Ferrari, Pagani, and Koenigsegg built lasting value.

04

Government Matching Funds

Non-dilutive capital reduction.

Investors benefit when OVIN, IRAP, SIF, and NRC match their investments with non-dilutive capital. This dramatically increases investor confidence.

05

Multi-Sector Usage Potential

Beyond automotive.

Thermal management, VCU, and torque vectoring logic transfer into marine, aerospace, EV startups, defence, and robotics. The platform is not limited to cars.

WHAT INVESTORS GAIN

Equity in a scalable R+D platform

-- Association with Canada's emerging national automotive identity

-- Access to multiple revenue streams simultaneously

-- First rights to IP licensing deals globally

-- A system that expands into marine, aerospace, EV startups, and defence

-- Long-term returns from continuous IP portfolio growth

-- The opportunity to shape Canada's automotive future

Why Now.

USMCA. Tariffs. Reshoring. EV transition. A once-in-a-century structural opening.

USMCA 2020-- THE POLICY SHIFT

75% North American content required

Up from 62.5% under NAFTA. Canadian suppliers become strategically essential, not optional.

Higher wage thresholds

Favours Canada and the US over Mexico for advanced component manufacturing.

Battery materials must be regional

Canada's lithium, nickel, and cobalt mining resources become central to EV supply chains.

EV subsidies require North American supply chains

For the first time in history, policy encourages Canadian-designed vehicles, not just assembly.

THREE FORCES CONVERGING IN 2024-25

Trade Pressure

American tariffs on Canadian goods and sovereignty threats exposed the risk of 92% export dependence on one trading partner. The structural vulnerability of building everything for someone else became a national conversation. Canada needed a domestic automotive identity -- not as aspiration, but as economic strategy.

Industrial Readiness

Canada now has the industrial conditions that Rimac, Koenigsegg, and Pagani did not have when they started: 700+ world-class suppliers, active government programs, and 70% of a hypercar already producible domestically. The infrastructure is in place. The coordination layer is not.

Cultural Momentum

F1 fan growth in Canada reached +31.5% year on year the second fastest globally. The Canadian Grand Prix generates \$162M CAD annually. Canadians are enthusiastic about high-performance automotive culture. They have simply never had a Canadian name to attach that enthusiasm to.

\$40B in Canadian subsidies went to foreign OEMs. Zero to a domestic platform. That equation can no longer be ignored. Canada is not starting from zero. It is starting from 70%. No other small-nation automotive project has that foundation. The audience exists. The appetite exists. The flag does not. Takaya provides the flag.

Globally, nations are defending their automotive sectors. This shift creates a historic opening for Canada. Takaya responds to this moment by unifying Canadian capabilities into a performance ecosystem.

Aligned Incentives.

Four groups. One platform. All incentives pointing in the same direction.

What makes Takaya structurally viable is not just the vehicle or the business model. It is the fact that every major stakeholder group — suppliers, government, investors, and the Canadian public has a different specific reason to want this platform to exist, and Takaya addresses all of them simultaneously. That alignment is by design.

VALUE PROPOSITION BY STAKEHOLDER

Suppliers

Magna Multimatic Linamar Martinrea Dana TM4

- IP authorship for the first time
- Named contribution in a Canadian system
- No conflict with existing OEM contracts
- Long-term platform to scale with
- A unified architecture above their crates

Government

ISED OVIN SDTC SIF NRC-IRAP

- Proof of national automotive IP ROI
- Alignment with EV and USMCA policy
- Reshoring narrative made concrete
- Domestic brand supporting sovereignty
- One platform that coordinates all programs

Investors

Angels, BDC Family Offices Strategic OEM

- Equity in a scalable technology platform
- Multiple revenue streams simultaneously
- Software IP with high-margin licensing
- Government matching reduces risk
- Multi-sector exit potential: defence, fleet, EV

Canadians

Public, Enthusiasts, Students, Designers

- The first performance brand from Canada
- A flag to drive under and cheer for
- A career path in Canadian automotive design
- National identity through engineering excellence
- Proof that Canada creates, not just manufactures

The structural conditions are in place. The stakeholders are aligned. The capability exists. What has never existed before is the platform that brings them together.

That platform is Takaya. End of Chapter 07.

The gap is not what Canada cannot build. It is what Canada has **not yet claimed.**

8

A modern performance car is built from 12 core systems, 70 or more subsystems, hundreds of interconnected components, multiple overlapping software layers, and tightly controlled mechanical, electrical, and aerodynamic interactions. When those 12 systems were mapped against Canada's existing supplier capability, **70 percent of the hypercar was already producible domestically.**

The remaining 30 percent, complete ICE engines, carbon ceramic brakes, high-discharge battery cells, and the full VCU software stack, were initially identified as gaps. What became clear through the research was that these gaps were not weaknesses. They were the IP roadmap.

Every missing capability is a development target. Every target, once reached, **becomes a licensable asset that Takaya owns permanently.**

WHAT THIS CHAPTER MAPS

P.41 -- The Gap Table -- 12 systems mapped against Canadian capability

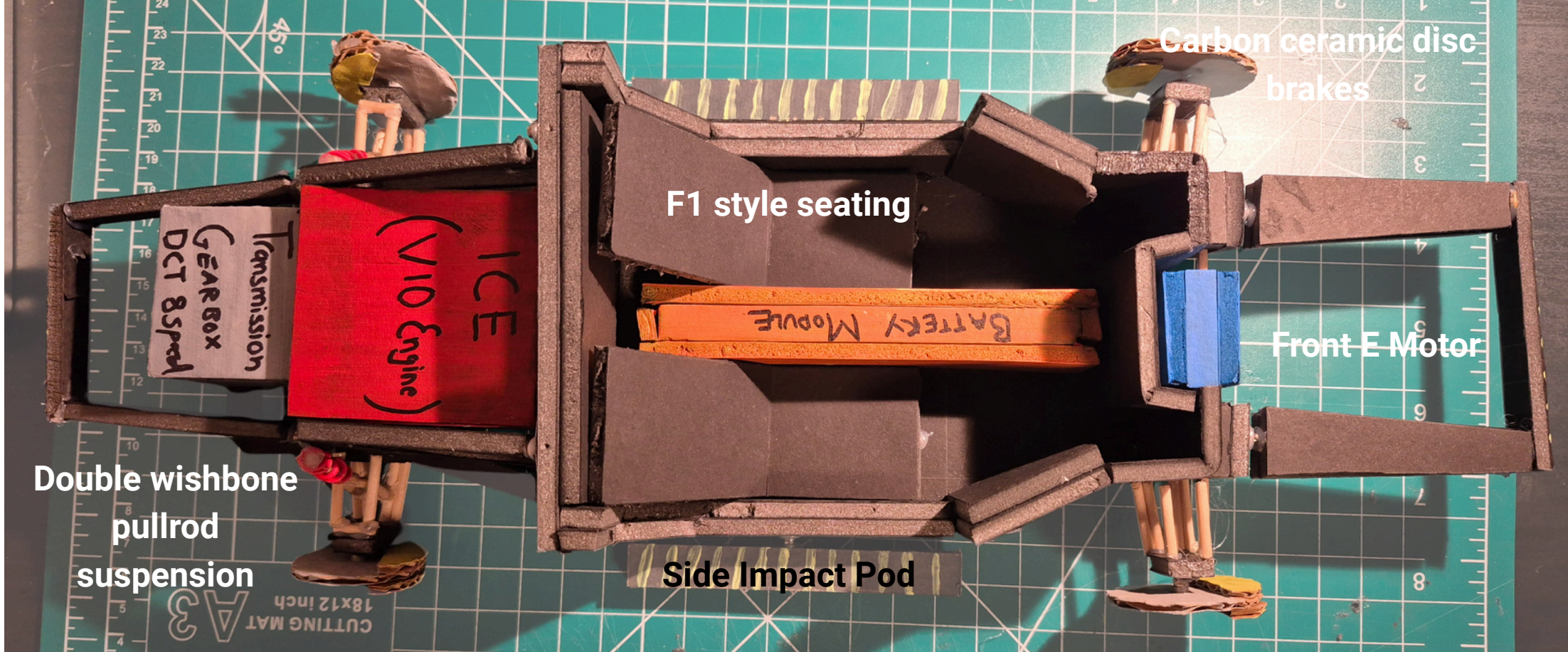
P.42 -- The 70/30 Visual -- what Canada has, what is missing, and why

P.43 -- The Gold Mine -- why the 30 percent is the most valuable part

P.44 -- Software Systems -- the 9 proprietary control systems Takaya develops

P.45 -- Software vs Hardware -- why software is the highest-margin layer

P.46 -- IP as a Permanent Asset -- the licensing model and compound value

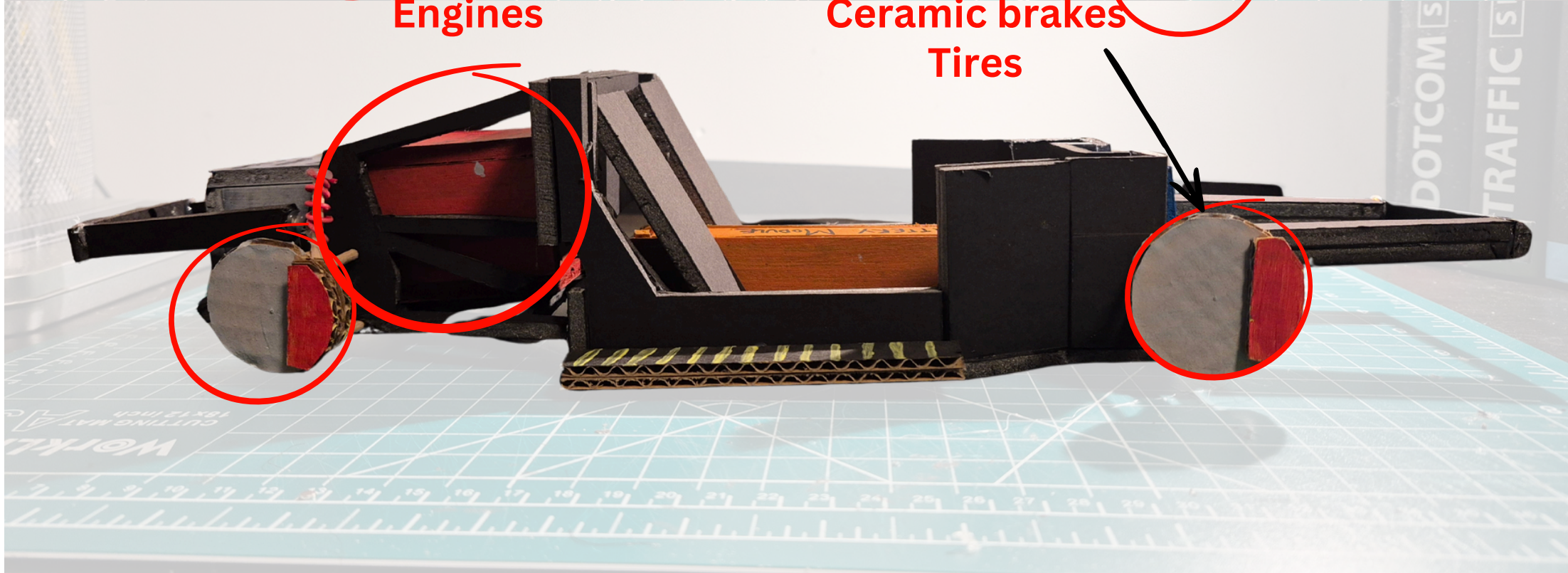




What Canada doesn't Makes?

Engines

Ceramic brakes
Tires



The Gap Table.

12 systems. What Canada has. What is missing. What each gap becomes.

Every gap is a development target. Every target reached becomes a licensable Takaya IP asset.

SYSTEM	CAN. CAPABILITY	GAP	IP CLASSIFICATION	TIMELINE	STATUS
Carbon Monocoque	100% Multimatic	None	License existing	Now	AVAILABLE
Suspension System	100% Multimatic DSSV	None	License existing	Now	AVAILABLE
Electric Motors	90% Dana TM4	10% integration	Co-develop	Now	NEAR-READY
Hybrid Gearbox / DCT	85% Linamar	15% software	Co-develop	Yr 1-2	IN PROGRESS
Aerodynamics + Body	80% Martinrea + Magna	20% active aero SW	Develop owned	Yr 1-3	IN PROGRESS
Electronics / ECUs	70% Magna ADAS	30% VCU stack	Highest IP priority	Yr 1-4	GAP, IP TARGET
Braking Hardware	65% Canadian Tier 1	35% ceramic discs	Partner source	Yr 2-4	GAP, IMPORT
Battery Pack Architecture	60% NextStar + NRC	40% cell chemistry	Build domestic	Yr 3-6	GAP, IP TARGET
Thermal Management	75% Magna	25% algorithm	Develop owned	Yr 1-3	IN PROGRESS
Complete ICE Engine	0% No domestic source	100% sourced	Long-term target	Yr 5+	GAP, PARTNER
Carbon Ceramic Brakes	0% Not established	100% imported	Mid-term target	Yr 3-5	GAP, IMPORT
Full VCU Software Stack	10% Early stage	90% to develop	Top IP priority	Yr 1-5	GAP, TOP PRIORITY

SUSPENSION SYSTEM ARCHITECTURE

In motorsports, a car must brake as late as possible, carry maximum speed through corners, and accelerate aggressively on corner exit. During these actions, the vehicle is constantly subjected to pitch, roll, and yaw forces. Under braking, the car pitches forward and loads the front tires. Under acceleration, the car squats and shifts weight rearward. During cornering, lateral forces cause body roll and camber change at the wheels.

The suspension system exists to manage these forces while keeping the tire contact patch as stable as possible. All suspension design decisions in this project were made as responses to these physical constraints, with a focus on track performance, future adaptability, and Canadian capability.



What exists already?

Canada does not manufacture complete suspension systems for hypercars or performance OEMs. However, it has world-class expertise in:

- Advanced damper technology
- Motorsports suspension components
- Precision machining and testing
- Control systems and vehicle dynamics

Canadian companies already supply critical suspension elements to Formula 1, Le Mans, and high-performance road cars, but these components are delivered as parts, not as a fully integrated Canadian-owned suspension architecture.

2. Suspension options explored

Several suspension architectures were studied before selecting the final configuration:

MacPherson strut

Common in mass-market vehicles due to packaging efficiency and low cost. Rejected because it offers limited camber control under high lateral loads and is not suitable for extreme track performance.

Multi-link suspension

Offers good road comfort and packaging flexibility, but introduces complexity and compromises precision when tuned for motorsports-level loads.

Double wishbone (outboard)

Provides strong camber control and predictable handling, but increases unsprung mass and limits aerodynamic packaging.

Double wishbone with inboard pushrod / pullrod actuation

This configuration separates the wheel control arms from the spring and damper units, allowing the suspension loads to be transferred into the chassis. This option was selected.

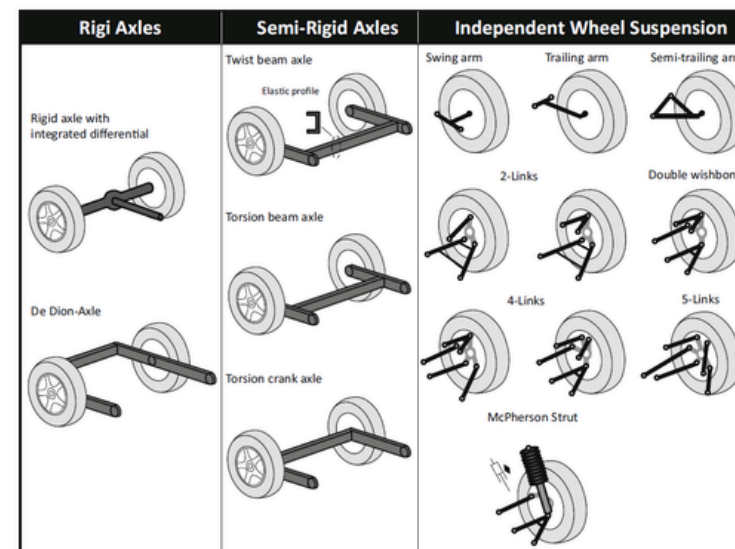


Fig. 7.3 Systematics of suspensions

Why This Configuration

This system:

- Maintains consistent camber during cornering
- Improves turn-in and steering precision
- Allows independent tuning at each wheel
- Supports torque vectoring and brake-by-wire systems
- Enables adjustable ride height and damping
- The suspension can operate at higher ride height for road use and poor surfaces, then lower itself for track driving. Controlled pitch under braking and squat under acceleration improve stability without compromising drivability.

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7 Suspension, Steering and Brake System

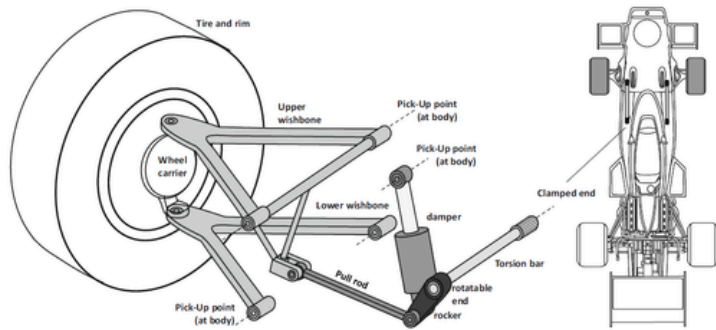


Fig. 7.7 Double wishbone with pull-rod and torsion bar on Lotus T72 (1970)

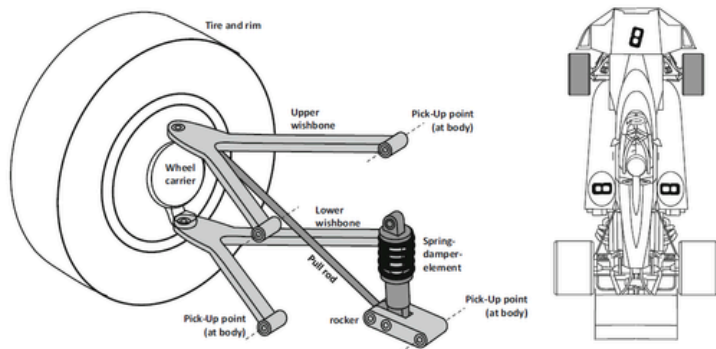


Fig. 7.8 Double wishbone with pull-rod and coil spring-damper element on Brabham BT44 (1974)

Road-Legal and Canadian Climate Considerations

This architecture allows compliance with road regulations by maintaining sufficient ride height, wheel travel, and durability for public use. Adjustable damping and ride height improve usability on uneven roads, cold surfaces, and seasonal conditions common in Canada, while still supporting aggressive track settings when required.

Canadian Capability and Opportunity

Canada already contributes advanced damper technology, precision manufacturing, and vehicle dynamics expertise. However, there is no Canadian-owned, track-focused suspension architecture developed as a complete system. This project defines that system-level opportunity, moving Canadian expertise from component supply toward integrated performance architecture.

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7 Suspension, Steering and Brake System

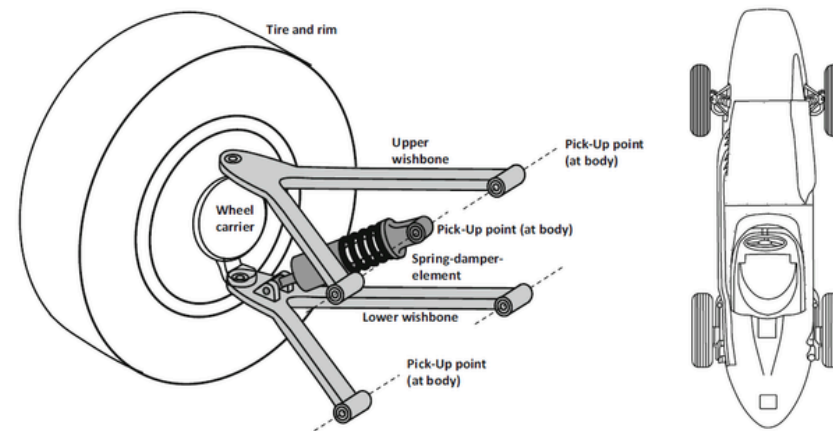


Fig. 7.5 Double wishbone with coil spring damper element on Aston Martin DBR9 (1959)

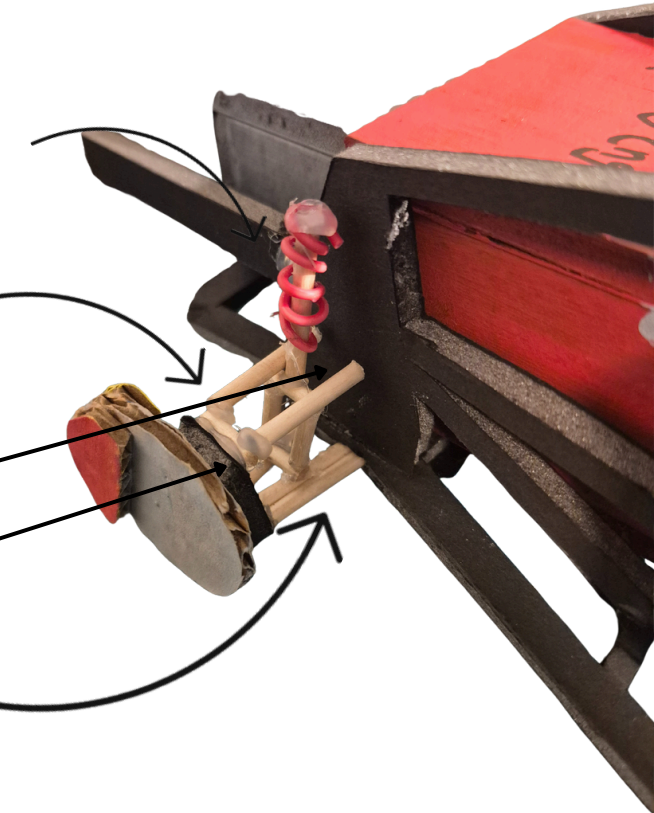
Springs and Dampers

Upper WishBone

Half-Axle

Suspension Hub

Lower Wishbone



BATTERY SYSTEM ARCHITECTURE

Context

In a modern track-focused hypercar, the battery is not just an energy source. It is a structural, thermal, and performance-critical system. It must deliver high power instantly, recover energy under braking, and remain stable under extreme heat, cold, and repeated load cycles.

This project treats the battery as a performance subsystem, not a range-driven EV pack.

What Exists Already

Canada is deeply involved in the battery supply chain, including:
Raw materials such as lithium, nickel, graphite, and rare earth elements
Battery research, testing, and cell development
Grid-scale and automotive battery manufacturing support

However, Canada does not currently produce a high-discharge, motorsport-oriented battery architecture designed specifically for performance vehicles.

Design Choice

The proposed system uses a high-power lithium-ion battery focused on discharge and regeneration rather than long-range capacity.

- Cell type: high-discharge pouch or prismatic cells
- Chemistry direction: nickel-rich lithium-ion (NMC or advanced NCA variants)
- Voltage architecture: high-voltage system optimized for power density

The battery is packaged as a central structural spine, running low and close to the vehicle's center of gravity.

Why This Is a Design Decision

This configuration:
Delivers instant power to front and rear electric motors
Supports regenerative braking to recover energy under deceleration
Stabilizes weight distribution and lowers center of gravity
Allows repeated track laps without thermal fade
Works with torque vectoring and brake-by-wire systems
This is a motorsport-first battery architecture, not a consumer EV solution.

Canadian Climate and Road Use Considerations

The system is designed to operate reliably in cold temperatures common in Canada. Thermal management prioritizes consistent performance in winter conditions while remaining safe and durable for road use. This ensures the car is usable beyond ideal track environments.

Internal System Architecture (How It Is Built)

Cells

High-discharge pouch or prismatic cells optimized for rapid energy delivery and recovery rather than maximum range.

Modules

Cells grouped into compact modules to allow thermal control, serviceability, and scalability.

Battery Pack / Spine

Modules are housed in a rigid enclosure that acts as a structural element within the vehicle's architecture.

Battery Management System (BMS)

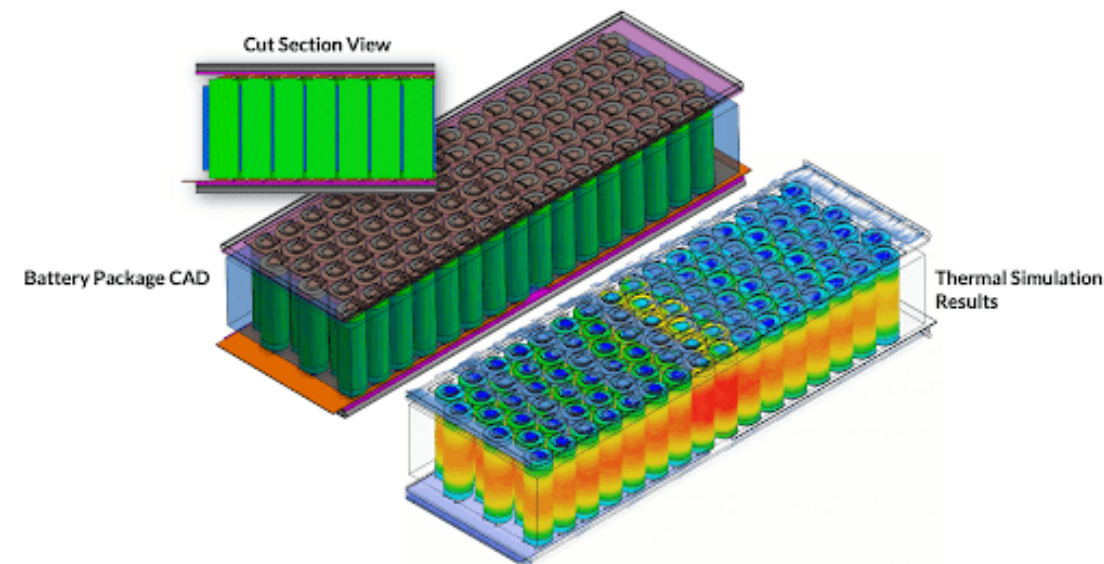
Monitors voltage, temperature, state of charge, and discharge rates to protect the system under extreme track loads.

Power Electronics

High-voltage connections feed front and rear electric motors and support regenerative braking.

Thermal System

Liquid cooling channels manage heat generated during acceleration and regeneration, ensuring repeatable performance.



Electric Motor System

Context

In modern motorsports, performance is no longer defined by peak horsepower alone. Cars must accelerate instantly out of corners, manage traction in changing conditions, and recover energy under braking. Electric motors are used not to replace the internal combustion engine, but to fill performance gaps created by physics: turbo lag, gear shifts, traction limits, and braking inefficiencies.

This project uses a hybrid electric motor architecture:

- Two independent electric motors at the front wheels
 - One electric motor integrated at the rear, assisting the ICE drivetrain
- The motors are paired with an internal combustion engine rather than replacing it.

Electric Motor System (E-Motors)

Proposed Output Targets

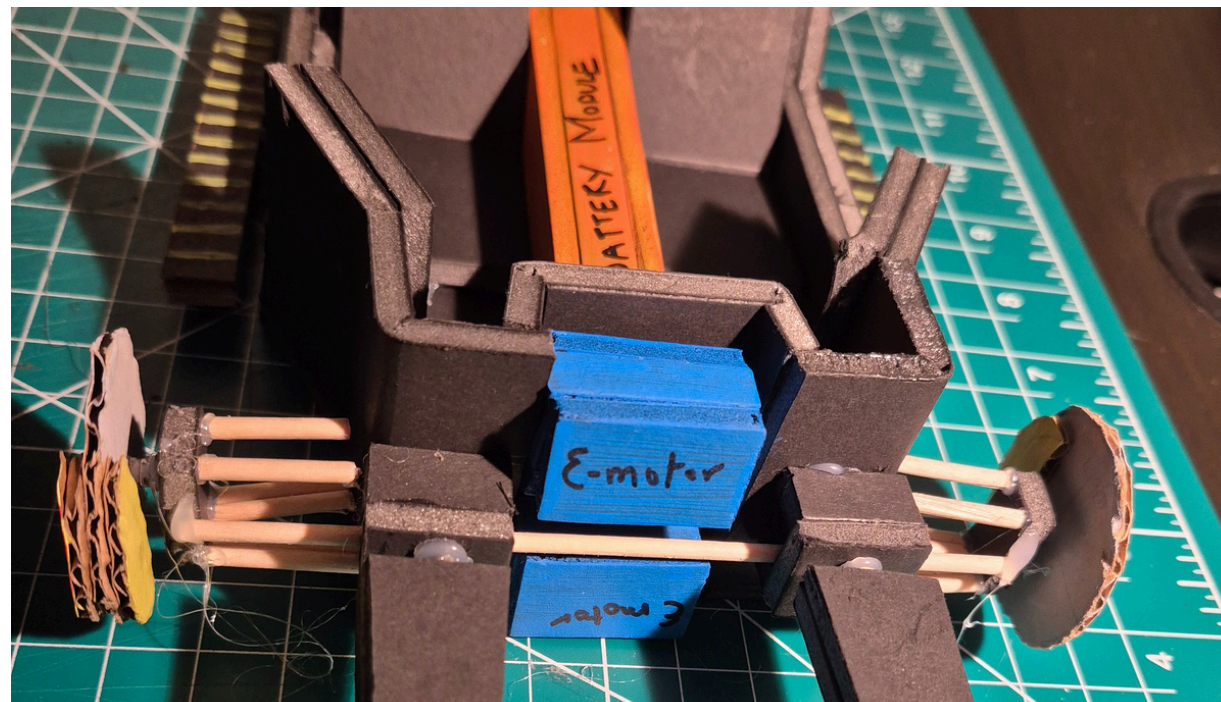
The electric system is sized for track performance, not range.

Front e-motors (2 total): 250 hp each, 500 hp total

Rear e-motor (1 total): 200 hp

Combined electric output: 700 hp

This is paired with the ICE to reach the overall target.



What each e-motor does in the architecture

Front left e-motor

Drives the front left wheel independently. Provides instant torque at corner exit and enables torque vectoring by increasing or reducing power relative to the other front wheel.

Front right e-motor

Drives the front right wheel independently. Works with the left motor to control yaw behavior, improve turn-in, and stabilize the car in low-grip conditions.

Rear e-motor

Supports the ICE drivetrain at the rear axle. Provides torque fill during gear shifts and low RPM, adds boost during acceleration, and switches to regenerative braking during deceleration to recover energy into the battery.

INTERNAL COMBUSTION ENGINE (ICE) – V12 SYSTEM ARCHITECTURE

Design Choice

The project uses a mid-mounted, naturally aspirated V12 as part of a hybrid performance system.

The engine is designed to function as:

- A high-RPM power source
- A sustained power delivery unit at high speeds
- An emotional and mechanical counterbalance to electrification
- It is paired with electric motors rather than used alone.

Why This Is a Design Decision

This engine configuration:

- Provides linear power delivery at high speeds
- Reduces vibration compared to lower-cylinder engines
- Maintains performance consistency during long track sessions
- Complements electric torque at low RPM
- Allows extreme throttle precision and driver feedback
- The V12 is chosen for performance stability and nostalgia.

Does Canada make engines?

Canada does not currently manufacture complete high-performance automotive engines, especially not V10s or V12s for hypercars.

However, that does not mean Canada is weak in engine capability.

Canada is strong in:

- Engine components
- Precision machining
- Powertrain validation and testing
- OEM engine assembly for mass-market vehicles
- Engineering services for global automakers

What Canada lacks is engine IP ownership, not engineering competence.

So how are we sourcing the engine?

The engine is externally sourced, but system-integrated in Canada.

That means:

The core ICE is developed with a specialist manufacturer

Canada owns the integration, packaging, cooling, hybridization, and validation

The engine becomes part of a Canadian-controlled system, not a drop-in part

Who could realistically build it?

Examples of non-Canadian but realistic partners:

- Cosworth
- Ilmor Engineering
- Ricardo
- AVL

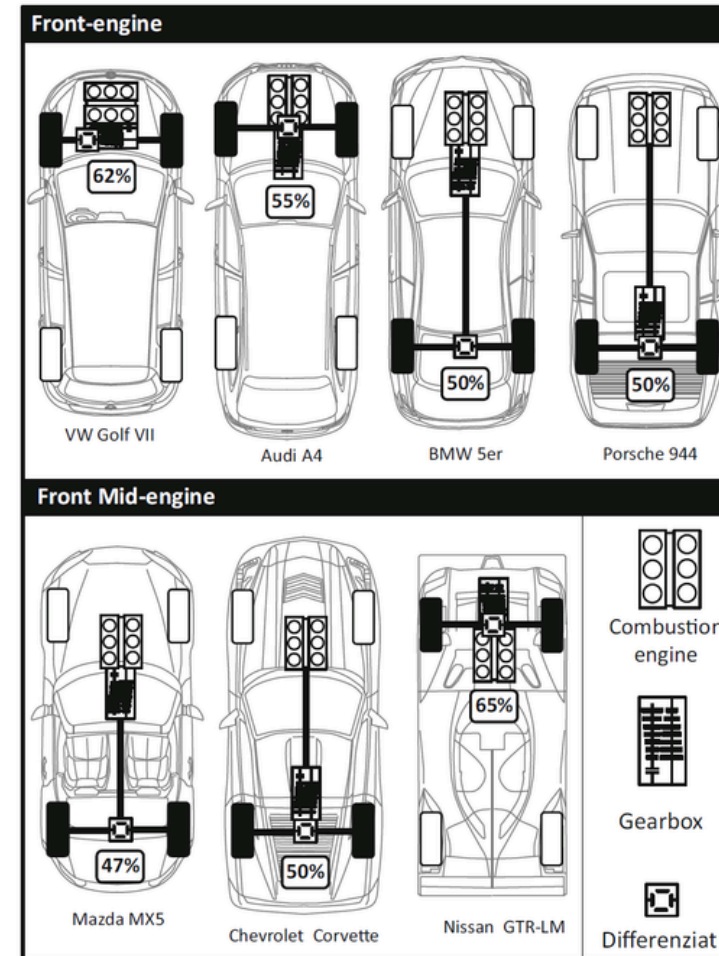


Fig. 9.2 Powertrain concepts with front and front-mid engine as combustion engine and single-axle drive



Why a V12 (not just performance, but emotion)

The decision to use a naturally aspirated V12 is not only technical – it is cultural and experiential. High-revving V12 engines represent the peak of analog motorsport emotion. They deliver:

- Linear power delivery
- Extremely high RPM capability
- A sound profile that creates a physical, emotional response

Cars like the Lexus LFA proved that engine acoustics, tuning harmony, and throttle response can become the identity of the car itself. In an era where many performance cars are becoming silent or digitally augmented, a V12 creates a memorable, visceral experience that enthusiasts actively seek. This is especially important for a halo car, it needs to be felt, not just measured.

How Canada can realistically do this

Canada may not manufacture complete V12 engines today, but it can own how the engine is experienced. Canada contributes by:

- Defining the engine's operating philosophy
- Specifying high-RPM behavior and throttle mapping
- Designing intake and exhaust resonance
- Integrating the engine into a hybrid system that enhances response rather than replacing it

Engine manufacturing can be handled by a specialist partner, but:

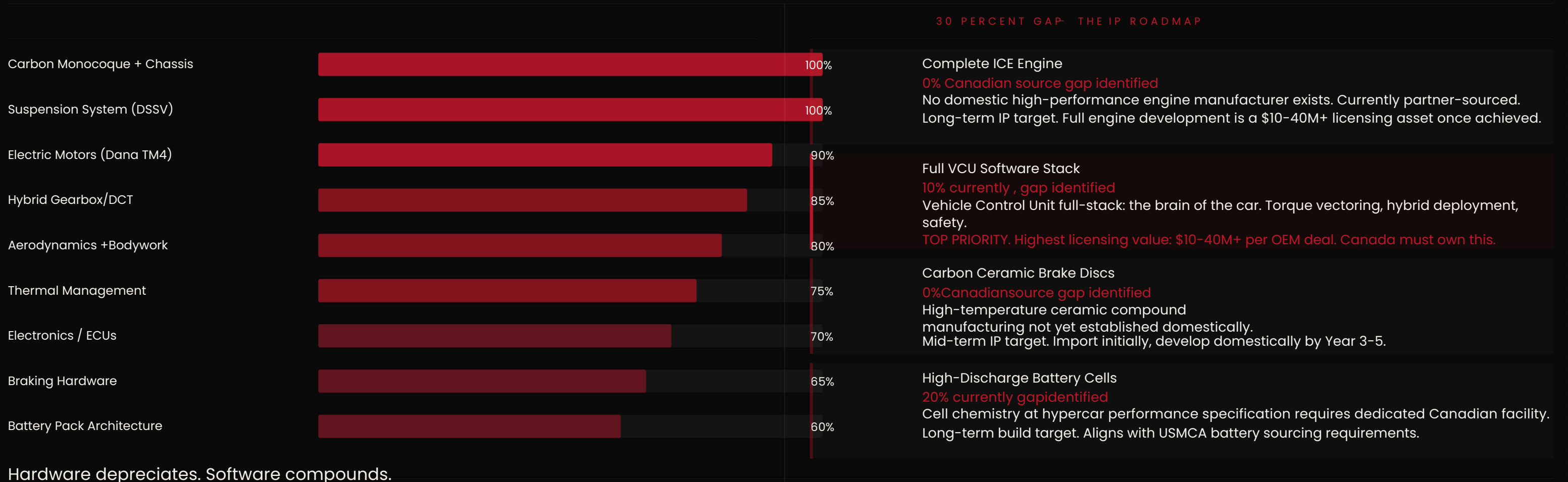
- Calibration
- Sound tuning
- Thermal management
- Structural integration

are controlled by the Canadian system architecture. This is where the identity is created.

70%

CANADIAN CAPABILITY BY SYSTEM

of a hypercar already producible in Canada.



Hardware depreciates. Software compounds.

Each drive cycle improves the IP. The 30% gap is not a deficit, it is the most valuable part of the platform.

The 30% is not a gap. It is a gold mine.

The instinct when mapping a capability gap is to see it as a deficit.
 The design instinct the systems level instinct is to see it as a target.
 Each gap in Canada's current capability is a development opportunity.
 Each development opportunity, when completed, becomes a technology asset. **Each technology asset is licensable to any OEM in the world.**

FROM GAP TO ASSET- THREE PHASES

Phase 1 : License

Year 1-2

Activate what Canada already has. License Multimatic DSSV dampers from day one ,already the global standard for performance vehicles. License Dana TM4 electric motors. License Magna thermal management. Build the 70% first. The hypercar validates all of it under extreme conditions. The IP value of each licensed system grows with each proven

- Multimatic DSSV suspension (license)
- Dana TM4 e-motors (license)
- Magna thermal systems (license)
- Carbon monocoque (license)
- Hybrid DCT gearbox (co-develop)

Phase 2 : Co-Develop

Year 3-5

Begin building proprietary systems with university and research partners. Battery management algorithm co-developed with Ontario Tech. Torque vectoring stack built through hypercar testing , the first major Takaya-owned IP asset. Brake-by-wire blending algorithm: ASIL-D certified, worth \$2-10M per licensing deal. Active

- Battery management algorithm (owned)
- Torque vectoring stack (owned)
- Brake-by-wire control (owned)
- Active aero system (owned)
- ISO 26262 safety monitor (owned)

Phase 3 : Own

Year 6+

Own the full VCU stack. This is the single most valuable IP asset in the Takaya portfolio. Every OEM in the world needs a vehicle control unit. A fully validated, ASIL-D certified, Canadian-owned VCU stack is worth \$10-40M per licensing deal. Add predictive torque management trained on hypercar telemetry data. Expand into defence, fleet,

- Full VCU stack : permanent IP
- Predictive torque management (AI-trained)
- Platform expansion IP (defence)
- Fleet efficiency module (new sector)
- Autonomous systems foundation (long-term)

The IP Roadmap.

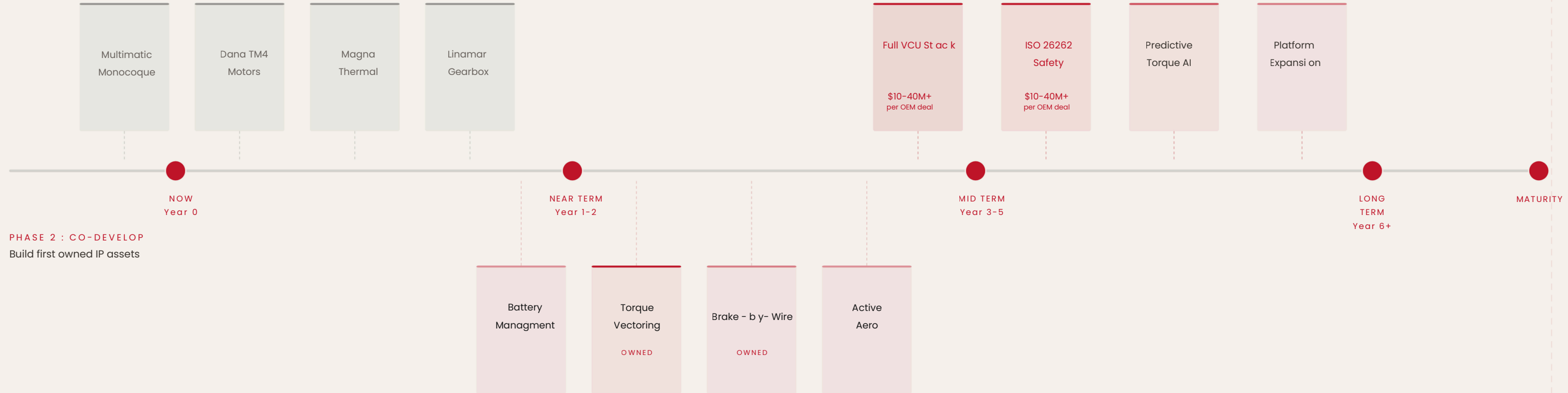
From licensed hardware to owned software. Phase by phase.

PHASE 1 -- LICENSE

Activate Canada's existing 70%

PHASE 3 -- OWN

Full software stack -- permanent IP



IP VALUE OVER TIME



Hardware depreciates from day one. Software IP compounds with every drive cycle, every data point, every licensing deal. **The gap is the roadmap. The roadmap is the asset. The asset belongs to Canada permanently.**

9 Proprietary Software Systems.

The intelligence layer. Every system Takaya develops and owns permanently.

From the ecosystem.pdf: The software and intelligence layer governs how the car actually behaves. It coordinates every hardware system, manages energy deployment, optimises lap time, and protects both the driver and the powertrain.

Takaya develops and owns all nine of these systems. They do not expire.

01 Vehicle Control Unit VCU

The central brain. Coordinates all ECUs, manages power modes, enforces safety limits. Top IP asset: \$10-40M+ per OEM deal.

02 Hybrid Energy Strategy HybridMaps

Governs when to use ICE, when to deploy electric motors, and how to blend both. Optimises power delivery across all conditions.

03 Torque Vectoring Algorithm TorqueVec.

Per-wheel power distribution. Controls yaw, cornering exit, and traction under load. Built from hypercar telemetry. First licensable Takaya asset.

04 Traction and Stability Control T+S Control

Wheel slip management, cornering stability, electronic differential logic. ASIL-B certified. Integrates with torque vectoring continuously.

05 Battery State Management SOC + SOH

State of charge and state of health monitoring. Thermal limits, discharge curves, regeneration thresholds. Proprietary algorithm per cell chemistry.

06 Active Aerodynamic Control AeroControl

Governs active wing, diffuser, and underbody systems in real time. Responds to speed, yaw rate, and braking events. Canadian winter validated.

07 Brake-by-Wire Blending BBW System

Blends regenerative and mechanical braking seamlessly. ASIL-D certified. Licensing value: \$2-10M per OEM deal. Safety-critical software.

08 Thermal Management Strategy Thermal Mgmt

Manages engine oil, coolant, battery thermal, and intercooler routing. Adaptive to ambient temperature. Canadian climate data embedded.

09 Over-the-Air Update Architecture OTAPlatform

Remote software deployment, version control, diagnostic access. Recurring revenue: \$20-60K per vehicle per year for life of the platform.

Software is the highest-margin layer.

Hardware depreciates. Software compounds. Every drive cycle improves the algorithm. Every algorithm improvement increases the licensing value. The car is the test bed. **The software is the business. This is the Rimac model applied to Canada.**

HARDWARE

Physical vehicles and components

Revenue model
One-time sale per unit. \$1.5M-\$2.2M per hypercar.

Margin
40-65% gross. Fixed cost per unit produced.

Depreciation
Hardware depreciates from delivery day one.

Scalability
Each new unit requires materials, labour, time.

IP ownership
Shared with suppliers who build the components.

Competitive moat
Replicable by any OEM with capital and tooling.

Compound growth
Linear. 20 units = 20 units of value delivered.

SOFTWARE IP

Proprietary algorithms and licensing

Revenue model
Recurring licensing. \$10-40M+ per OEM deal plus OTA.

Margin
85-95% gross after initial development. Near-zero COGS.

Depreciation
Software improves with use. Value compounds over time.

Scalability
One algorithm licensed to 100 OEMs simultaneously.

IP ownership
100% Takaya. Permanent. Not dependent on any supplier.

Competitive moat
Training data and validation history cannot be replicated.

Compound growth
Exponential. More data = better model = higher value.

THE COMPOUND GROWTH MODEL



IP as a Permanent Asset.

Once developed, it belongs to Canada. No OEM can take it back.

This is the fundamental difference between the Takaya model and every previous Canadian automotive attempt. Bricklin produced cars until it ran out of money. Project Arrow produced a prototype that exists in a museum. Neither produced an asset that continued generating value after the program ended. Takaya is designed to produce IP. The car is how the IP gets proven.

TAKAYA IP ASSET CLASSES

Tier 1 -- Foundational \$10-40M+ per OEM deal

Full VCU stack, torque vectoring algorithm, ISO 26262 safety monitor. The core control architecture that every OEM needs. Highest licensing value. Most defensible competitive model.

Tier 2 -- System-Level \$2-10M per deal

Brake-by-wire blending, active aerodynamic control, battery SOC management. Validated under hypercar conditions. Available to specialty OEMs, motorsport teams, and EV startups.

Tier 3 -- Module-Level \$500K-\$2M per deal

Thermal management algorithms, energy mapping strategies, traction control logic. Individually licensable. Crate module system itself can be licensed to universities and engineering schools.

Tier 4 -- Recurring \$20-60K per unit per year

Over-the-air update architecture, telemetry platform access, performance monitoring. Recurring revenue stream that grows with the fleet. Continuous cash flow from existing customers.

HOW THE PRECEDENTS BUILT IP

Rimac

Croatia--started 2009

Built Concept One hypercar to prove the platform. IP licensed to Porsche, Bugatti, Hyundai. Now valued in the billions. Software revenue exceeds car sales. Takaya follows this model exactly.

Cosworth Electronics

UK racing, started in F1

Developed control electronics for racing. Now supplies F1, WEC, IndyCar, and Supercars. Revenue comes from IP and software, not from building the cars themselves.

Takaya's VCU follows this path.

Multimatic

Toronto, started as a supplier

Developed DSSV dampers for racing. Now supplies Ferrari, McLaren, Aston Martin. The technology is licensed globally. The supplier became the IP holder. Canadian precedent for Takaya's model.

The car proves the platform. The platform generates the IP. The IP belongs to Canada.

End of Chapter 08. Chapter 09 maps the crate ecosystem that makes this possible.

The crate is not a new idea. It is the only idea **that works here.**

9

A crate is a complete, self-contained module that performs a specific function and can be manufactured independently, transported easily, installed or replaced as a unit, and integrated into a larger system.

A crate is not one part. It is a whole subsystem packaged together.

This idea exists across every high-performance industry.

The GPU in a computer is a crate. The avionics module in a Boeing is a crate. The prefab bathroom unit in a hotel is a crate. Koenigsegg's early hypercars used a Ford V8 crate, AP Racing brakes crate, and supplier electronics crate **before developing their own. That is the closest parallel to Takaya.**

WHAT THIS CHAPTER COVERS

P.47 -- What is a Crate -- the concept and why it works

P.48 -- The 12 Takaya Crates -- all subsystems mapped

P.49 -- Crate Analogies -- GPU, Avionics, Koenigsegg parallels

P.50 -- How Crates Connect to Vehicle Architecture -- macro/meso/micro

P.51 -- Distributed Manufacturing -- no factory required

P.52 -- Risk Reduction vs Full OEM -- why the crate model is safer

P.53 -- The Crate as IP -- how each module generates licensable value

What is a Crate?

A complete, self-contained module. Not one part. A whole subsystem.

A crate performs a specific function and can be:

Manufactured independently

Each supplier builds their crate in their own facility. No single factory required.

Transported as a unit

The crate ships complete. Takaya HQ receives it ready to integrate.

Installed or replaced cleanly

Service ability by design. A faulty crate is swapped, not rebuilt.

Integrated into a larger system

The crate connects to the vehicle architecture through defined interfaces.

Evolved independently

Each crate improves without disrupting adjacent systems.

A crate ecosystem is when multiple crates from different experts are interconnected, compatible, standardised, and designed to work together. It turns scattered subsystems into a coherent platform.

It allows multiple companies to collaborate without losing specialisation.

It accelerates innovation because each crate evolves independently.

This is the structure that Canada's scattered supplier excellence has

always been capable of and has never had a platform to express.

THE CRATE CONCEPT ACROSS INDUSTRIES

Computer Industry : GPU

The graphics card is a crate. Built by Nvidia.

Plugged into different PCs by different

manufacturers. Used by Apple, Dell, HP, Lenovo

simultaneously. Upgradable without changing the rest

Takaya parallel: Dana TM4 motor crate slots into Takaya architecture exactly as a GPU slots into a motherboard.

Aerospace : Avionics Modules

Airbus and Boeing assemble aircraft from modular

avionics units: navigation crates, communication

crates, power crates, and flight control crates.

Each module is built by a specialist , Honeywell,

Takaya parallel: Takaya HQ is the airframe integrator. Magna, Multimatic, and Linamar are the avionics specialists.

Koenigsegg : Closest Automotive Parallel

Koenigsegg's early hypercars used a Ford V8 crate

engine, AP Racing brakes crate, and supplier

electronics crates. They built their own innovation

crates: the Freevalve system, their gearbox, their

This is the exact Takaya model. License first. Co-develop second. Own permanently third.

The 12 Takaya Crates.

One crate per sub system. One specialist per crate. One platform above all.

Each crate is a complete, independently manufactured subsystem. Each is built by a Canadian specialist. Each connects to Takaya HQ through defined mechanical and software interfaces. Each generates its own IP.

01 Power Delivery

Hybrid V10+forced induction + power electronics

Supplier: Linamar / Partner
PARTNER / LICENSE

04 Cooling + Thermal

Radiators, intercoolers, battery cooling, oil coolers

Supplier: Magna Thermal
PARTNER / LICENSE

07 Suspension + Handling

Double wish bone pull rod, DSSV dampers, geometry

Supplier: Multimatic
PARTNER / LICENSE

10 Safety System

ASIL-D monitor, ABS, stability, functional safety

Supplier: Takaya HQ --
owned IP
OWNED IP

02 Hybrid Architecture

MGU-K fronte-axle, inverters, battery management

Supplier: Dana TM4 + Magna
PARTNER / LICENSE

05 Braking System

Carbon ceramic discs, 6-piston calipers, brake-by-wire

Supplier: Brembo + Takaya SW
PARTNER / LICENSE

08 Control Software

VCU, ECUs, torque vectoring, hybrid maps, OTA

Supplier: Takaya HQ -- owned IP
OWNED IP

11 Electronics + Sensors

Wiring harness, telemetry, wheel speed, TPMS

Supplier: Magna Electronics
PARTNER / LICENSE

03 Aerodynamics

Active wings, diffuser, venturi tunnels, fan system

Supplier: Martinrea + Takaya HQ
PARTNER / LICENSE

06 Steering System

Electricpowersteering,rear-wheel steering logic

Supplier: ZF + Takaya SW
PARTNER / LICENSE

09 Structural System

Carbon monocoque tub, subframes, crash structures

Supplier: Multimatic
PARTNER / LICENSE

12 Interior + Ergonomics

F1 wheel, digital cluster, HUD, harness, pedal box

Supplier: Takaya HQ + NRC
PARTNER / LICENSE

Crates 08 and 10 are entirely Takaya-developed and owned. These are the highest-value IP assets in the platform.

Crate Analogies.

The concept is proven across every high-performance industry.

The crate model did not originate in automotive design. It originated wherever high complexity, distributed expertise, and modular scalability converged. Every industry that solved the problem of assembling world-class components **from multiple specialists into a unified, reliable system used crate logic.**

Smartphones ; Apple iPhone

Apple does not manufacture every component. Sony builds the camera module crate. TSMC fabricates the processor crate. Samsung supplies the memory crate. Corning produces the glass crate. Broadcom delivers the wireless crate. Apple curates, integrates, and designs

Takaya parallel: Takaya HQ is Apple. Magna, Multimatic, and Linamar are Sony, Samsung, and TSMC. The integration is the product.

SpaceX Falcon 9 Rocket

SpaceX assembles the Falcon 9 from prefab avionics crates, battery crates, control system crates, and modular Merlin engine crates. The rocket is not built as a single monolithic structure. It is assembled as a high-performance modular ecosystem where each system is

Takaya parallel: The hypercar is assembled the same way. Each crate arrives validated. Takaya HQ integrates. The vehicle is the proof.

Airbus A350 ; Avionics Architecture

The A350 uses navigation crates from Honeywell, communication crates from Collins Aerospace, flight control crates from Thales, and power distribution crates from Safran. Airbus does not manufacture any of these systems. Airbus designs the architecture,

Takaya parallel: Like Airbus, Takaya defines the architecture. Suppliers contribute their crates. The designer owns the integration logic.

Koenigsegg; Automotive Closest Parallel

Koenigsegg's early cars used a Ford V8 engine crate, AP Racing brakes crate, and supplier electronics crates.

Each generation, Koenigsegg replaced a partner crate with an owned crate: first the Freevalve engine system, then the Koenigsegg LST gearbox, then their proprietary

This is the exact Takaya model in sequence. License existing. Co-develop next. Own permanently. Repeat.

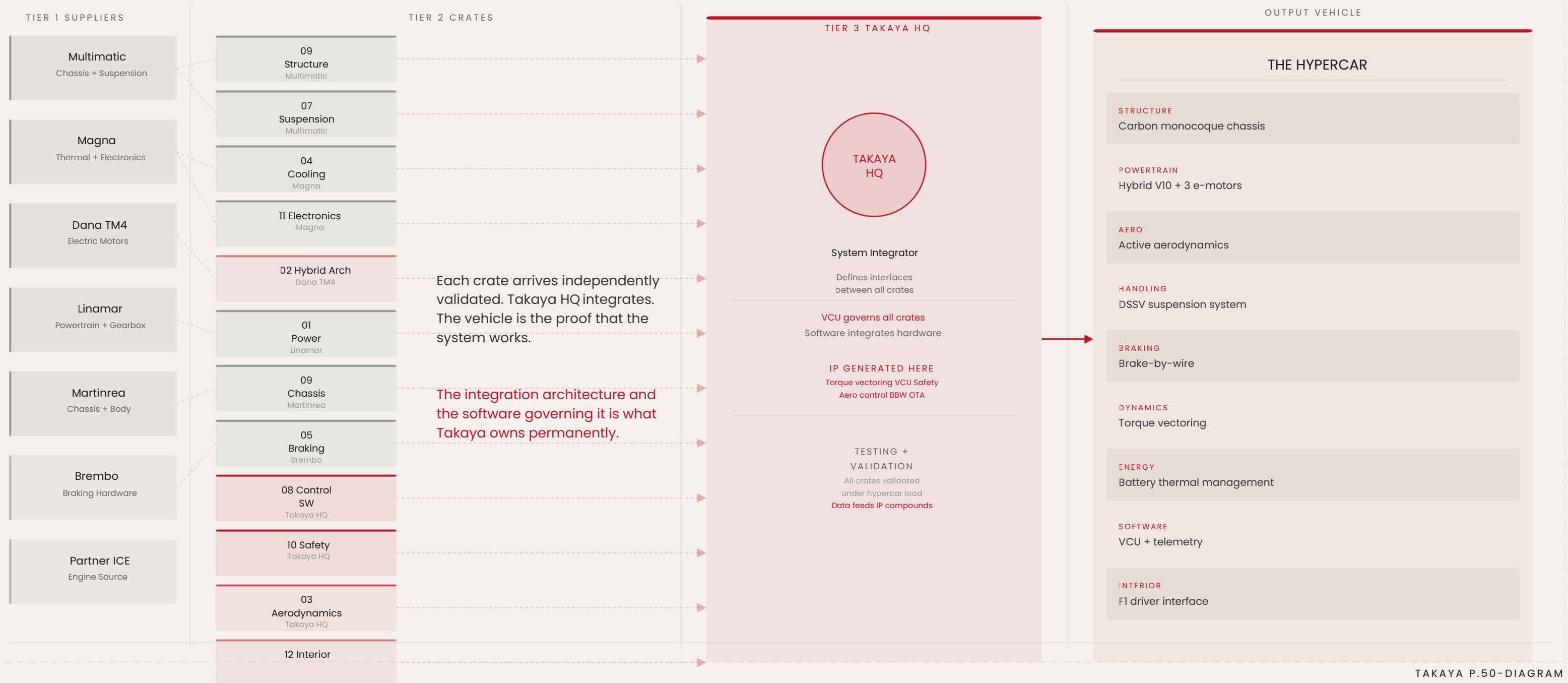
THE COMMON THREAD

In every case: one integrator defines the architecture. Multiple specialists build the modules.

The integrator owns the platform. The specialists own their crate. Both benefit from the system. **Takaya is the integrator. Canada's suppliers are the specialists. The platform is Canadian.**

Crate Architecture.

How 12 independent modules connect in to one integrated vehicle system.

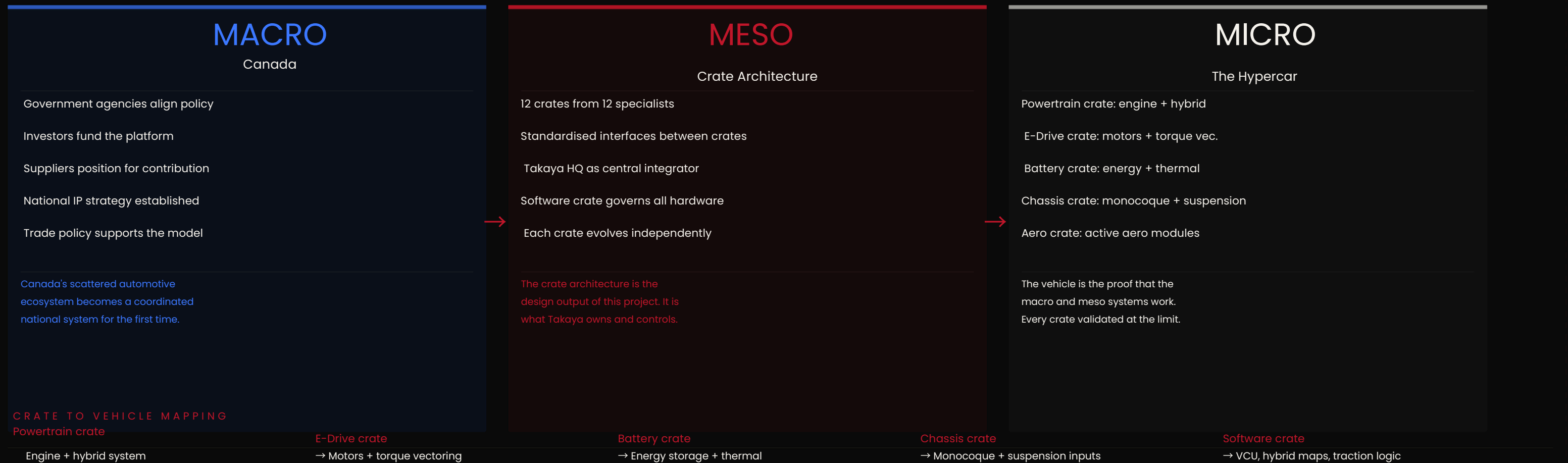


Macro. Meso. Micro.

Three scales. One coherent system. The crate connects all three.

The crate ecosystem operates at three scales simultaneously.

At the macro level, it coordinates national policy, supplier capability, and government investment into a single aligned platform. At the meso level, it defines how 12 crates from different specialists connect through standardised mechanical and software interfaces. At the micro level, each crate becomes *a validated vehicle subsystem that performs under hypercar conditions.*



No factory required.

Distributed manufacturing. One integrator. Twelve specialists.

Traditional OEM thinking assumes that a car company needs a factory. That assumption is responsible for the failure of every previous Canadian attempt. Bricklin built a factory in New Brunswick. The factory failed before the car did. **The crate model eliminates this dependency entirely.**

HOW DISTRIBUTED MANUFACTURING WORKS

01 Takaya HQ defines the architecture

Not the components. The interfaces between components. The performance specifications each crate must meet. The integration logic that governs how they connect.

02 Specialist suppliers build their crate

Each in their own facility. Each to Takaya's specification. Each independently tested and validated before delivery. No shared factory. No shared overhead.

03 Crates are delivered to an assembly partner

Multimatic in Toronto can assemble the complete vehicle. They already do this for Ford and Aston Martin. The relationship exists. The capability is proven.

04 Takaya HQ integrates and validates

The VCU software that Takaya owns governs every crate simultaneously. Integration testing confirms the system works as a whole. The hypercar is the proof.

05 Each crate is serviceable independently

A failed crate is replaced, not rebuilt. This is the service ability advantage that no traditional OEM can match at this price point.

TRADITIONAL OEM vs TAKAYA CRATE MODEL

DIMENSION	TRADITIONAL OEM	TAKAYA CRATE MODEL
Factory investment	\$500M-\$2B required	Zero suppliers build in their own facilities
Tooling	\$50M-\$200M per model	Shared with existing OEM contracts
Assembly workforce	2,000-5,000 employees minimum	Partnership model with Multimatic
Break-even volume	50,000+ units per year	20-30 units per year, pre-sold
Time to first vehicle	5-8 years minimum	3-4 years with crate model
IP ownership	Shared with factory and tooling partners	100% Takaya architecture and software
Serviceability	Specialised dealer network required	Crate swap modular by design
Risk profile	Catastrophic if volume targets missed	Isolated each crate risk is independent

The crate model does not require Canada to build a new automotive industry. **It requires Canada to coordinate the world-class automotive industry it already has.**

Risk Reduction vs Full OEM.

The crate model does not eliminate risk. It isolates it.

In a traditional OEM, a failure in one subsystem can cascade across the entire program. A battery recall costs billions. A gearbox failure stops production. A software bug grounding the entire fleet. Systemic risk is the defining liability of mass manufacturing. **The crate model contains each failure at the crate level.**

RISK PROFILE: TRADITIONAL OEM vs CRATE MODEL

RISK TYPE	TRADITIONAL OEM	RISK TYPE	TAKAYA CRATE MODEL
Capital risk	\$1.5B+ committed before first unit	Capital risk	\$12.5M-\$25M incremental deployment
Volume risk	50,000 units needed to break even	Volume risk	20-30 units pre-sold before production
Supplier failure	Cascades to full production stop	Supplier failure	One crate replaced, others continue
Software defect	Recall of entire fleet	Software defect	OTA update to affected crates only
Technology obsolescence	Entire factory retooled at massive cost	Technology obsolescence	Single crate upgraded independently
Brand failure	Billion-dollar write-off	Brand failure	Program concludes. IP retained permanently.
Government dependency	Fully dependent for survival	Government dependency	Funding is additive, not foundational

The crate model does not ask Canada to take a \$1.5B bet on a single outcome. It asks Canada to take 12 smaller bets, each independently manageable.

Every crate is a potential IP asset.

The crate model is not just a manufacturing strategy. It is an IP generation strategy.

Each crate that Takaya co-develops or builds internally becomes a module that can be licensed to any OEM, university, motorsport team, or EV startup globally.

The integration architecture above the crates is itself the most valuable asset.

CRATE IP VALUE BY CATEGORY

Takaya-Owned Crates

Highest value -- permanent IP

Control Software crate - VCU + torque vectoring + hybrid maps

Safety System crate - ASIL-D certified functional safety

Active Aero crate - validated in Canadian winter conditions

Brake-by-Wire crate - regen blending algorithm

OTA Platform - recurring revenue per vehicle per year

\$10M-\$40M+ per licensing deal

Co-Developed Crates

Shared IP -- partial licensing rights

Battery crate - SOC/SOH algorithm co-owned with NRC

Hybrid Architecture crate - energy mapping co-developed

Thermal Management crate - algorithm co-owned with Magna

Suspension crate - active geometry software layer

Steering crate - rear-wheel steering logic developed

\$2M-\$10M per licensing deal

Licensed Crates

Partner IP -- usage rights only

Structural crate - Multimatic carbon monocoque

Power Delivery crate - partner ICE engine sourced

E-Drive crate - Dana TM4 motors licensed

Electronics crate - Magna ADAS hardware

Interior crate - ergonomics co-designed

License fee paid outbound -- no inbound revenue

This is how Koenigsegg built a licensing business. It is how Takaya does the same for Canada.

The ecosystem is not a diagram. It is a living system.

10

The ecosystem is designed for multiple end-users, not just drivers. Mapping how each stakeholder interacts with HQ, suppliers, and the crate system clarified how the ecosystem functions as a living system. *Every interaction generates data. Every data point improves the platform.*

This chapter maps how five distinct user groups interact with the ecosystem, what they contribute, and what they receive in return. It also maps the transition from eco system logic to physical system architecture: *how the service layer became the engineering brief.*

WHAT THIS CHAPTER COVERS

P.54 – Full Ecosystem Map – all stakeholders and interactions

P.55 – Supplier Interaction – crates in, integration feedback out

P.56 – Government + Investor Interaction – funding loops

P.57 – Driver + Enthusiast Interaction – telemetry and modes

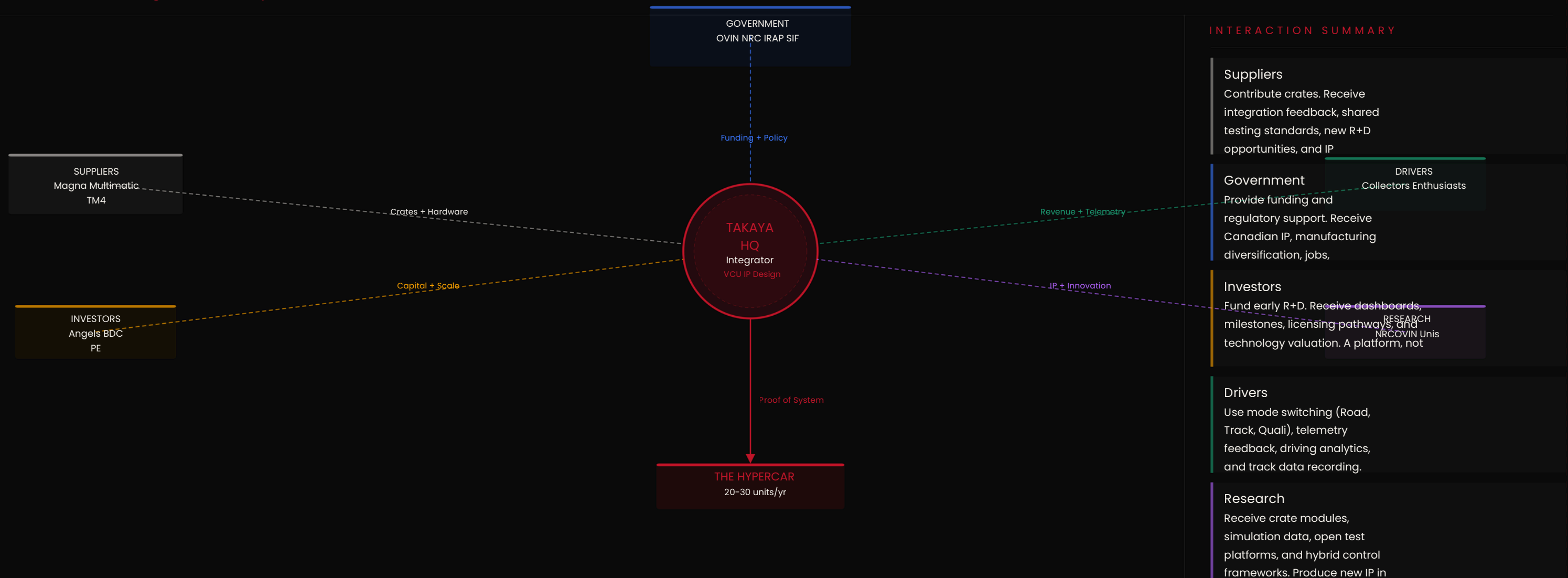
P.58 – Students + Research Labs – the innovation pipeline

P.59 – Transition to Architecture – from service map to vehicle brief

Full Ecosystem Map.

Government enables. Suppliers build. HQ integrates. Investors scale. Users validate.

The ecosystem follows a proven pattern seen in Ford vs Ferrari, Rimac, Koenigsegg, and Pagani: government enables the project, suppliers provide specialised modules, HQ integrates and designs, investors scale it, and users validate it through real-world performance feedback.

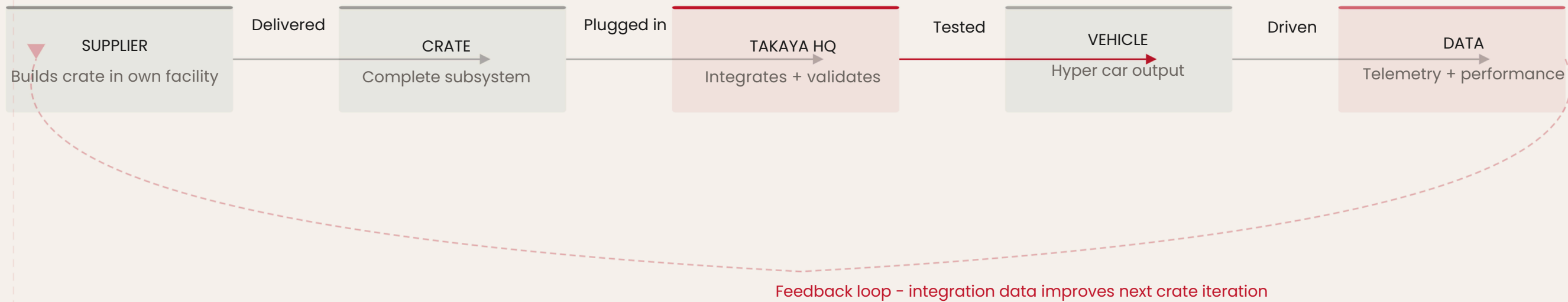


Supplier Interaction.

Crates in. Integration feedback out. IP collaboration throughout.

Suppliers contribute crates into the ecosystem: hybrid gearbox crates, motor and inverter crates, monocoque crates, battery crates, aero components. In return, suppliers receive integration feedback, shared testing standards, new R+D opportunities, and IP collaboration.

This transforms isolated suppliers into a unified Canadian performance framework.



SUPPLIER GIVE AND RECEIVE

Multimatic	Magna	Dana TM4	Linamar	Martinrea
GIVES: Carbon monocoque + DSSV dampers RECEIVES: Integration spec + performance data + IP	GIVES: Thermal systems + electronics RECEIVES: Testing standards + next-gen thermal algorithm	GIVES: E-motors + inverters RECEIVES: Torque vectoring integration data + EV architecture	GIVES: Powertrain + gearbox RECEIVES: Hybrid deployment logic + DCT calibration data	GIVES: Chassis + body structures RECEIVES: Aerodynamic load data + structural optimisation

Funding the Platform.

Government positions. Investors fund. Both receive more than they put in.

GOVERNMENT

OVIN NRC IRAP SIF ISED Federal + Provincial

WHAT GOVERNMENT PROVIDES

Non-dilutive funding through NRC-IRAP and SDTC

Research access through OVIN and NRC programs

Industry connections and procurement pathways

Regulatory support and certification access

Trade policy alignment through USMCA mandates

WHAT GOVERNMENT RECEIVES

Canadian IP ownership – software and crate architecture

Manufacturing diversification beyond foreign OEM assembly

High-skill job creation in system integration and software

National prestige: the first Canadian performance platform

Export potential through IP licensing to global OEMs

INVESTORS

Angels BDC Family Offices Strategic OEM Private Equity

WHAT INVESTORS PROVIDE

Early R+D stage capital to reach first prototype

Scaling capital for GT variant and SUV expansion

Brand equity through association with national platform

Strategic OEM partnerships that open licensing doors

Market access through existing automotive networks

WHAT INVESTORS RECEIVE

Equity in a scalable technology platform, not a car company

Access to hardware, software, and platform revenue simultaneously

Government matching reduces their capital at risk significantly

First rights to IP licensing deals worth \$10M-\$40M+ per OEM

Multi-sector exits: defence, fleet, EV startups, aerospace

The key structural advantage: government matching funds reduce investor risk. Both parties benefit from the same platform simultaneously.

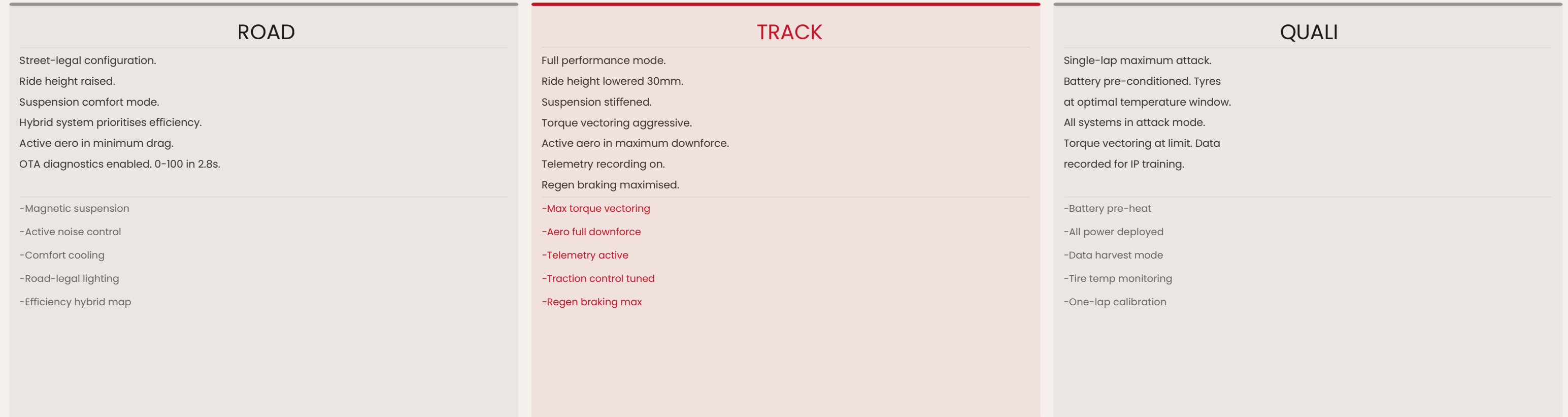
Driver Interaction.

The car is not a luxury object. It is a learning machine.

Drivers use mode switching (Road, Track, Quali), telemetry feedback loops, driving analytics, track data recording, and performance coaching.

What they gain: better driving ability, longer track sessions, **predictable performance, and a national identity product.**

THREE DRIVER MODES



THE TELEMETRY LOOP



The Innovation Pipeline.

Students and researchers feed the ecosystem. The ecosystem creates the next generation.

Students and researchers receive: crate modules, simulation data, open test platforms, hybrid control frameworks, and aero testing modules.

What they produce: new IP, improved crate designs, software improvements, and engineering talent. Value: creates a national innovation pipeline.

WHO PARTICIPATES

OCAD University

Industrial design, service design, UX, brand identity
Takaya's own origin point -- crate ecosystem originated here

University of Waterloo

Mechanical, electrical, software, autonomous systems
Mechatronics research directly applicable to VCU development

University of Toronto

Aerospace, materials, robotics, AI
Carbon fibre research and predictive torque AI foundation

Ontario Tech / UOIT

EV systems, battery, powertrain, thermal
Battery management algorithm co-development target

NRC + OVIN Labs

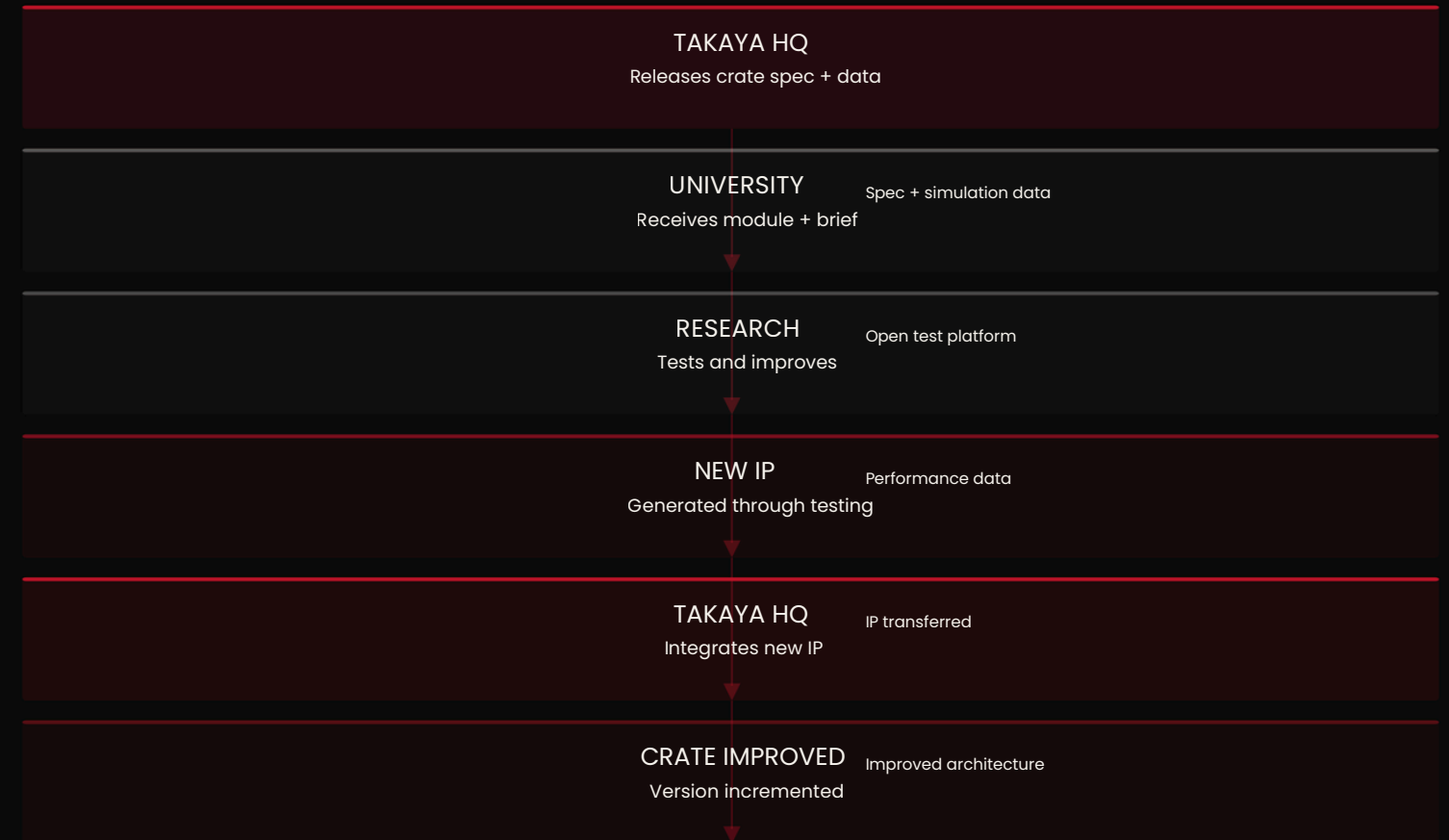
Applied research, testing, certification
Physical validation of crate modules and safety systems

Ryerson / TMU

Engineering design, sustainability, manufacturing
System integration research and crate interface standards

The research pipeline creates two outcomes: better crates and better engineers. Both stay in Canada. Both compound the national automotive IP base.

INNOVATION PIPELINE FLOW



From Network to Mechanics.

The service map became the engineering brief.

The ecosystem research established what the platform needed to do.
Each stakeholder interaction defined a performance requirement.
Each requirement became a design constraint. Each constraint drove
a specific engineering decision in the vehicle architecture.

HOW SERVICE INSIGHTS BECAME ENGINEERING DECISIONS

SERVICE INSIGHT	ENGINEERING DECISION	SYSTEM AFFECTED
Suppliers need modular, independently replaceable crates	Carbon monocoque with bolt-on subframe architecture for clean crate interfaces	Chassis + Structural
Drivers need predictable mode-switching between Road and Track	VCU with three distinct software maps governing all subsystems simultaneously	Control Software
Investors need the software to be separable and licensable	9 proprietary algorithms developed as standalone modules with defined APIs	IP Architecture
Research labs need open crate platforms for testing	Standardised mechanical and software interfaces on every crate	Crate Ecosystem
Government needs proof of Canadian content and IP	Majority of hardware sourced from named Canadian suppliers by design	Supplier Selection
Telemetry must feed back into IP development	Embedded data collection at 50Hz across all vehicle sensors into cloud	Electronics + VCU
Cold-weather validation as a Canadian differentiator	Thermal management designed for -30C to +40C ambient operating range	Cooling + Thermal

The ecosystem was not background research. It was the design brief.
Every engineering decision in the vehicle architecture traces back to a specific service insight.

Design decisions in this project are not based on form first.

The design decisions in this project are not based on aesthetic preference.

They are based on understanding the physical forces that govern high-performance vehicles and creating an architecture that manages those forces in a controlled, intentional way. Every subsystem that follows responds to both vehicle dynamics requirements and Canadian opportunity.

In motorsports, a car must repeatedly perform three actions: brake as late as possible, maintain grip through corners, and accelerate aggressively on to straights. The challenge is not generating power. It is controlling how the vehicle behaves under load. This behavior is governed by three primary vehicle dynamics: Pitch. Roll. Yaw.

WHAT THIS CHAPTER COVERS

- P.60 - Vehicle Dynamics - Pitch, Roll, Yaw as the design foundation
- P.61 - Additional Dynamics - CoG, unsprung mass, tire contact patch
- P.62 - Suspension Architecture - why double wishbone pullrod was chosen
- P.63 - Battery Spine Architecture - structural, thermal, and performance
- P.64 - Electric Motor System - three-motor torque vectoring layout
- P.65 - V12 + Tradition vs Future - emotion, sound, nostalgia, relevance
- P.66 - Braking + Transaxle - brake-by-wire, DCT, system integration
- P.67 - Monocoque + VCU - carbon structure and control unit architecture

Pitch. Roll. Yaw.

The three forces every design decision responds to.

In motorsports and track-focused driving, a car must repeatedly perform three actions: brake as late as possible, maintain grip through corners, and accelerate aggressively.

These actions expose the vehicle to extreme dynamic forces.

The challenge is not generating power - it is controlling how the vehicle behaves under load.

PITCH

Longitudinal Load Transfer

Pitch refers to the forward and backward rotation of the vehicle body. During braking, the centre of mass shifts forward, causing the front of the car to dive. During acceleration,

UNCONTROLLED EFFECTS

- Uneven tire loading
- Reduced braking efficiency
- Loss of traction during acceleration
- Instability in aerodynamic performance

TAKAYA RESPONSE

Structural battery spine positioned low and central. Monocoque geometry tuned to resist pitch moments under

ROLL

Lateral Load Transfer

Roll occurs when the vehicle experiences lateral forces during cornering. As the car turns, weight shifts to the outside wheels, causing the body to roll. Excessive roll

UNCONTROLLED EFFECTS

- Understeer or oversteer
- Reduced cornering grip
- Loss of driver confidence
- Camber change at wheel

TAKAYA RESPONSE

Double wishbone pull rod suspension selected specifically for roll control. Each wheel controlled

YAW

Rotational Control

Yaw refers to the rotation of the vehicle around its vertical axis, particularly during corner entry and exit. Too little yaw results in understeer. Too much leads to

UNCONTROLLED EFFECTS

- Determines willingness to rotate
- Linked to power delivery
- Linked to braking behavior
- Linked to suspension geometry

TAKAYA RESPONSE

Three-motor torque vectoring layout controls yaw by adjusting per-wheel power. The VCU manages yaw in real

Every subsystem in this project exists to manage one or more of these three forces under extreme track conditions. This is not an abstraction. It is the foundation from which every engineering decision in the architecture was made.

Additional Dynamic Considerations.

Centre of gravity. Unsprung mass. The tire contact patch.

Beyond pitch, roll, and yaw, three additional factors govern performance architecture. These are not secondary considerations. They are system-level constraints that shaped every packaging and layout decision in the Takaya architecture.

Centre of Gravity (CoG)

CoG plays a major role in pitch and roll behaviour.

A lower centre of gravity improves stability and responsiveness.

This is why the battery is packaged.

The battery spine, mid-engine layout, and carbon monocoque geometry are all CoG decisions.

Unsprung Mass

Unsprung mass refers to the mass of components not supported by the suspension -- wheels, brakes, hubs.

Excessive unsprung mass reduces how quickly the

Every gram removed from unsprung components directly improves tire contact patch stability.

The Tire Contact Patch

The tire contact patch is the final point where all systems converge. Every subsystem in this car -- suspension, aerodynamics, braking, torque vectoring,

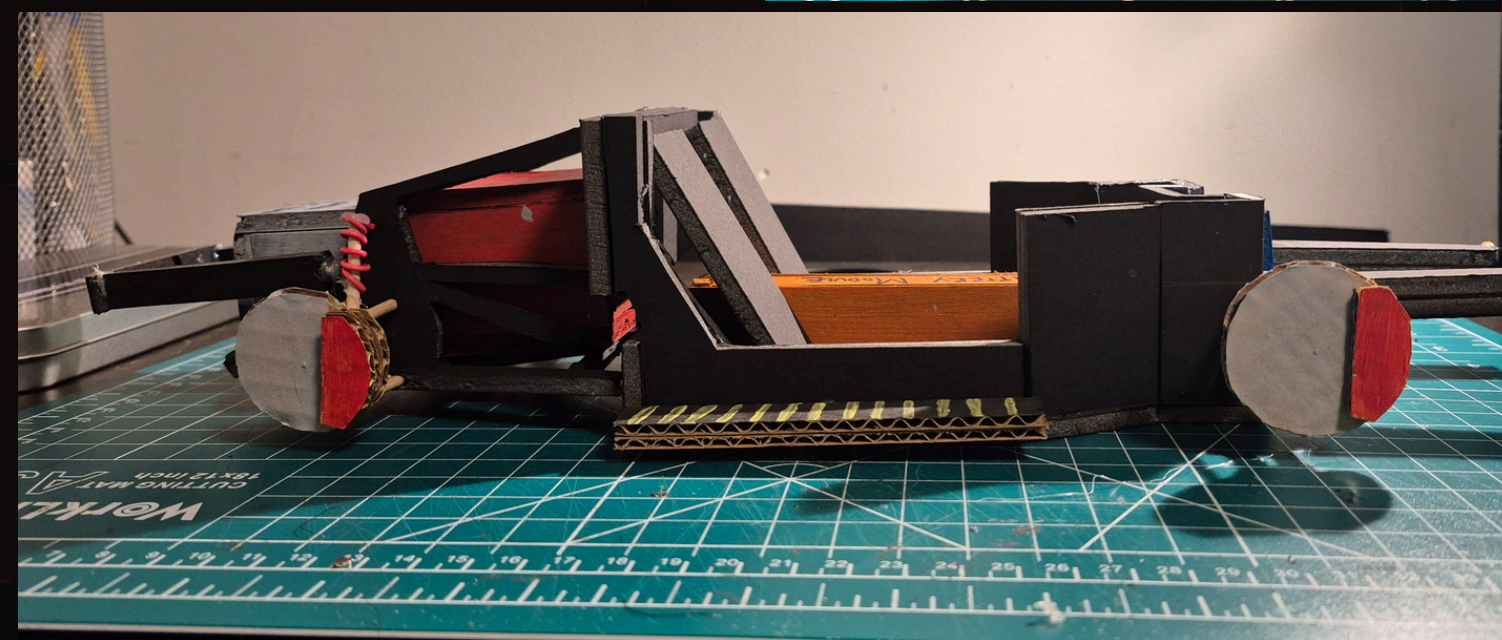
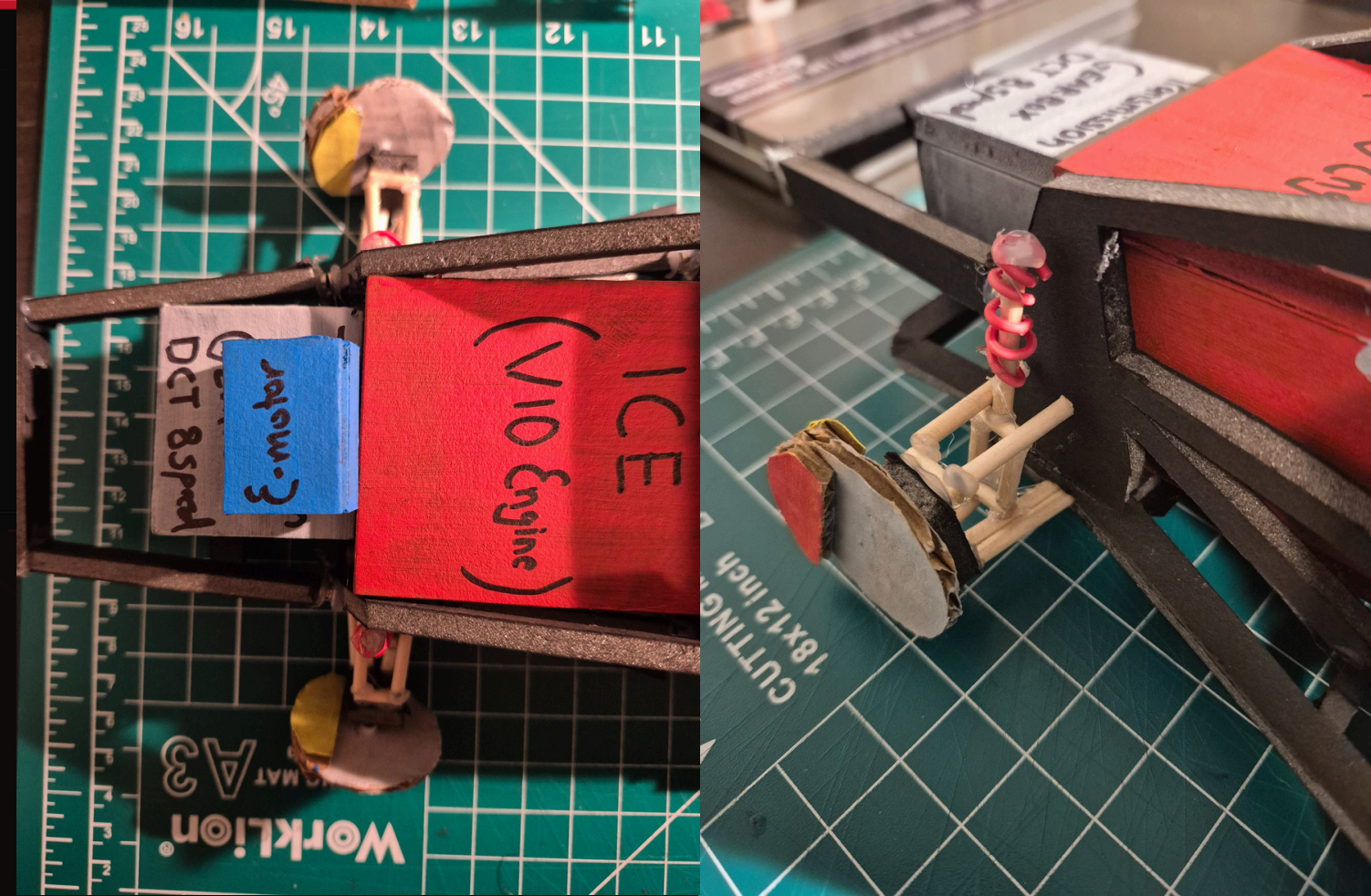
This is the most important sentence in this chapter: everything serves the contact patch.

Thermal Management

Sustained performance depends on how well systems

manage heat under continuous load. Thermal management is a limiting factor in track performance

Canadian winter conditions become an advantage: cold ambient air is a thermal performance asset.



Suspension Architecture.

Why double wishbone pullrod was selected. What was rejected. Why it matters.

In motorsports, a car must brake as late as possible, carry maximum speed through corners, and accelerate aggressively on corner exit. The suspension system exists to manage pitch, roll, and yaw forces while keeping the tire contact patch as stable as possible.

All suspension decisions in this project were made as responses to these physical constraints.

SUSPENSION OPTION EXPLORED

MacPherson Strut

REJECTED

Common in mass-market vehicles for packaging efficiency and low cost. Rejected because it offers limited camber

Multi-Link Suspension

REJECTED

Good road comfort and packaging flexibility, but introduces complexity and compromises precision when

Double Wishbone Outboard

REJECTED

Provides strong camber control and predictable handling, but increases unsprung mass and limits

Double Wishbone Pullrod + Inboard Actuation

SELECTED

Separates wheel control arms from the spring and damper units. Loads are transferred into the chassis.

This option was selected.

WHY THIS CONFIGURATION

- Maintains consistent camber during cornering
- Improves turn-in and steering precision
- Allows independent tuning at each wheel
- Supports torque vectoring and brake-by-wire
- Enables adjustable ride height and damping
- Operates at higher ride height for road use
- Lowers for track driving -- controlled pitch and squat

260 7 Suspension, Steering and Brake System

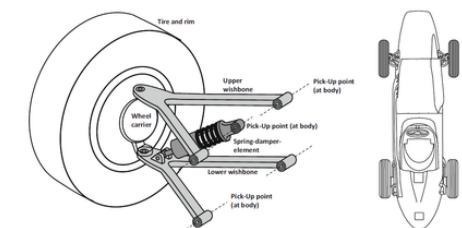


Fig. 7.5 Double wishbone with coil spring damper element on Aston Martin DBR9 (1959)

Springs and Dampers

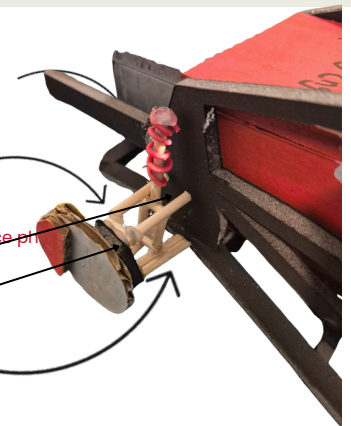
Upper WishBone

shbone geometry -- place ph

Half-Axle

Suspension Hub

Lower Wishbone



Canadian Capability:

Multimatic DSSV dampers are already the global standard for performance suspension.

Built in Toronto. Used in Formula 1. The suspension crate is Canadian from day one.

Battery Spine Architecture.

Not an energy source. A structural, thermal, and performance-critical system.

In a modern track-focused hypercar, the battery is not just an energy source. It must deliver high power instantly, recover energy under braking, and remain stable under extreme heat, cold, and repeated load cycles. This project treats the battery as a performance subsystem, not a range-driven EV pack.

DESIGN CHOICE

Cell type

High-discharge pouch or prismatic cells optimised for rapid energy delivery and recovery

Chemistry

Nickel-rich lithium-ion NMC or advanced NCA variants. High voltage architecture for power

Packaging

Central structural spine running low and close to the vehicle's centre of gravity. Below the driver.

Function

Delivers instant power to front and rear electric motors. Supports regenerative braking.

Thermal

Liquid cooling channels manage heat during acceleration and regeneration for repeatable

Climate

Designed to operate reliably in temperatures from -30C to +40C. Canadian winters are a test condition.

This is a motorsport-first battery architecture, not a consumer EV solution. The spine position lowers CoG, stabilises weight distribution, and improves both pitch and roll.

BATTERY SYSTEM INTERNAL ARCHITECTURE



Cells

High-discharge pouch/prismatic. Optimised for rapid delivery and recovery.

Modules

Cells grouped for thermal control, serviceability, and scalability.

Spine Structure

Modules housed in a rigid enclosure acting as a vehicle structural element.

BMS

Monitors voltage, temperature, state of charge, and discharge rates.

Power Electronics

High-voltage connections feed front and rear motors plus regen braking.

Thermal System

Liquid cooling channels manage heat for repeatable track performance.

Three-Motor Torque Vectoring.

Electric motors are not a replacement. They are a performance enhancement.

500hp(front)+200hp(rear)= 700 hp electric.
Paired with V12 ICE to reach 1,200-1,400 hp total.

Electric motors are used not to replace the internal combustion engine, but to fill performance gaps created by physics: turbo lag, gear shifts, traction limits, and braking inefficiencies.

This project uses a hybrid electric motor architecture paired with the ICE.

THE THREE-MOTOR LAYOUT

Why this is a design decision This layout directly addresses motorsport demands:

FRONT LEFT
E- MOTOR

250 hp

Drives the front left wheel independently. Provides instant torque at corner exit and enables torque vectoring by increasing or reducing power relative to the other front wheel.

COMBINED ELECTRIC OUTPUT

FRONT RIGHT
E- MOTOR

250 hp

Drives the front right wheel independently. Works with the left motor to control yaw behavior, improve turn-in, and stabilize the car in low-grip conditions.

REAR E-MOTOR

200 hp

Supports the ICE drivetrain at the rear axle. Provides torque fill during gear shifts and low RPM, adds boost during acceleration, and switches to regenerative braking during deceleration to recover energy into the battery.

LAYOUT DIRECTLY ADDRESSES MOTORSPORT DEMANDS

- Instant torque delivery during corner exit
- Torque vectoring at the front axle for improved turn-in and stability
- Filling power gaps during gear shifts
- Regenerative braking to recover energy under heavy braking
- Reduced reliance on mechanical differentials

Tradition. Future. **Emotion.**

The decision to use a naturally aspirated V12 is not only technical.

It is cultural and experiential.

High-revving V12 engines represent the peak of analog motorsport emotion.

Cars like the Lexus LFA proved that engine acoustics, tuning harmony, and throttle response can become the identity of the car itself. In an era where many performance cars are becoming silent or digitally augmented, a V12 creates a memorable, visceral experience that enthusiasts actively seek.

This is especially important for a halo car. It needs to be felt, not just measured.

THE V12 -- TRADITION

- Linear power delivery -- no turbo surge or lag
- Extremely high RPM capability -- 9,500 to 10,000 RPM
- A sound profile that creates a physical emotional response
- Smooth torque curve for driver confidence on corner exit
- Reduced stress per cylinder vs smaller turbo engines
- Visceral analog character in an increasingly digital era

Felt, not just measured.

HYBRID ELECTRIFICATION -- FUTURE

- 700 hp electric fills gaps the V12 cannot -- corner exit, gear shifts
- Regenerative braking recovers energy, reduces thermal stress
- Torque vectoring: per-wheel control impossible with ICE alone
- Cold-weather performance improved by electric torque at low temp
- Software-controlled power delivery improves with every drive cycle
- Relevance and competitiveness in a world moving beyond pure ICE

Competitive, not just nostalgic.

Canada has no automotive legacy to inherit. This is the advantage:

it can combine nostalgia with future-focused engineering from the outset. The V12 provides the emotional anchor. Hybridisation ensures relevance.

Braking. Transaxle.

Two systems that define the car's character at the limit.

BRAKING SYSTEM

Carbon ceramic discs+brake-by-wire+regenerative integration

Design Choice: carbon-ceramic disc brakes combined with brake-by-wire, integrated with regenerative braking from the electric motors.

Handles extreme heat

Repeated high-speed braking without fade. Carbon-ceramic maintains consistency lap after lap.

Reduces unsprung mass

Carbon-ceramic discs are significantly lighter than steel equivalents.

Consistent braking

Performance maintained on track regardless of temperature or brake wear state.

Regen integration

Seamless blending of mechanical and regenerative braking through the VCU.

Precise modulation

Brake-by-wire allows digital management of braking force rather than mechanical linkage.

Canadian contribution

Control systems and software expertise. Intelligence of the braking system is Canadian-led.

Front brake calipers are larger than rear because motorsports cars brake heavily and the centre of mass shifts forward under braking. More control needed at the front.

TRANSAXLE + 8-SPEED DCT

Rear-mounted transaxle combining gearbox and differential

A transaxle combines the gearbox and differential at the rear of the car. In a mid-engine layout, this allows engine, transmission, and driven wheels **to function as one compact, mass-centralised system.**

WHY 8-SPEED DCT:

Faster gear shifts

No power interruption during shifts. Closer gear ratios for better acceleration.

Wider ratio spread

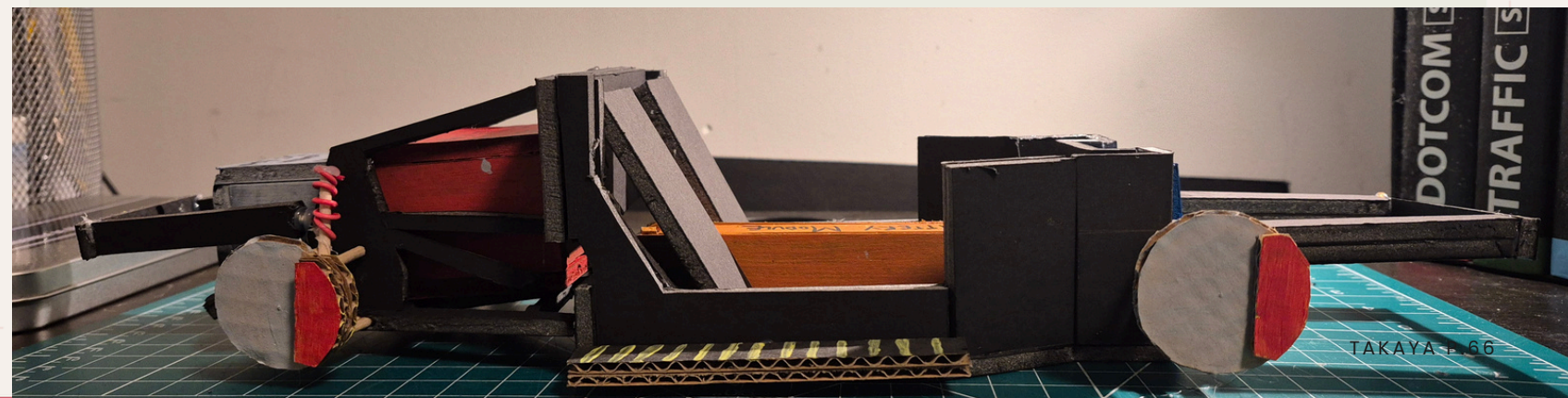
Both low-speed control and high top speed from one transmission.

Hybrid integration

Better integration with electric motors than manual or single-clutch systems.

Road legality

Smooth low-speed driving in traffic. Controlled delivery on snow or wet surfaces.



Monocoque. VCU.

The structure that holds everything. The brain that controls everything.

CARBON MONOCOQUE

The carbon-fibre monocoque acts as the core of the vehicle architecture. It is the fixed reference for all other subsystems, suspension mounting points, seating position, battery placement, and structural load paths. The monocoque is extremely stiff, providing high torsional rigidity which allows the suspension and vehicle control systems to function accurately under high **cornering, braking, and acceleration forces.**

Carbon tub

The main structural cell. Extreme torsional stiffness. Formed in one piece.

Front subframe

Attached to the monocoque. Carries suspension, crash structure, front e-motors.

Rear subframe

Carries V12, transaxle, rear motor, suspension. Bolt-on for serviceability.

Crash structures

Sacrificial components front, rear, and sides. Deform to protect the tub.

Battery integration

Spine battery is structural -- it contributes to torsional rigidity of the chassis.

Canadian supplier: Multimatic, Toronto. Already produces the Aston Martin Valkyrie monocoque. The structural crate is Canadian from day one.

End of Chapter 11. Chapter 12 begins the system architecture design and physical prototyping.

VEHICLE CONTROL UNIT

The VCU is the central system that coordinates all power, braking, and stability systems. It turns separate components **into one controlled vehicle.**

Torque Vectoring

Controls torque at each wheel independently. Improves corner rotation, reduces understeer, increases corner exit speed, and improves stability in low-grip conditions.

Power Blending

Fills torque gaps during gear shifts. Assists the engine at low RPM. Smooths acceleration curve. Eliminates power interruption between ICE and electric motors.

Braking Coordination

Blends regenerative braking from motors with mechanical braking from carbon-ceramic discs. Improves energy efficiency and reduces brake thermal stress.

Vehicle Dynamics

Monitors steering angle, wheel speed, yaw rate, pitch, and roll. Adjusts torque and braking in real time to maintain control under all conditions.

Road + Track Modes

Adapts the full system for snow, ice, cold temperatures, and urban driving from the same hardware platform. Canadian winter conditions are designed into the operating envelope, not treated as edge cases.

The VCU is the highest-value IP asset in the Takaya platform. Every OEM in the world requires a vehicle control unit. A fully validated, ASIL-D certified, Canadian-owned VCU stack is worth \$10M to \$40M+ per licensing deal. The VCU is also the system that improves with every drive cycle — more data means a better model means a higher licensing value.

From diagram to physical model.

Chapter 11 established the engineering logic behind every subsystem.

Chapter 12 documents how those systems were translated into physical form through low-to-medium fidelity prototyping, layout validation, and packaging study.

The question was not whether the systems work in theory.

It was whether they fit together and how they talk to each other.

The architecture adopted a three-line build philosophy inspired by how Koenigsegg and other precision integrators approach assembly:

Line 1 builds the front structure. Line 2 builds the powertrain and battery.

Line 3 brings them together in a marriage the moment the car becomes one system.

WHAT THIS CHAPTER COVERS

P.68 -- Chapter Overview -- subsystem relationships and layout logic

P.69 -- The Three-Line Build Philosophy -- how Takaya assembles

P.70 -- The Marriage -- when subsystems become one vehicle

P.71 -- Front Chassis Line -- structure, crash, front e-motors

P.72 -- Powertrain + Battery Line -- spine, ICE, transaxle, rear motor

P.73 -- Systems Integration -- VCU wiring, thermal, brake-by-wire

P.74 -- Physical Prototype -- low-to-medium fidelity model documentation

P.75 -- Packaging Validation -- seating, CoG, human factors

12

Subsystem Architecture.

How 12 systems talk to each other. Every interface is a design decision.

In a hypercar, no subsystem operates in isolation. The battery informs the thermal system.

The thermal system informs the cooling layout. The cooling layout informs the

aerodynamics. The aerodynamics inform the ride height. The ride height informs the suspension geometry. The suspension informs the VCU. The VCU governs everything.

Every interface between systems is a design decision. Ignoring it produces conflict. Resolving

it intentionally is what system architecture means.

SYSTEM A	SYSTEM B	INTERACTION	DESIGN IMPLICATION
Battery Spine	Thermal Management	Battery generates heat under high-discharge. Thermal system must manage cell temperature to prevent performance fade.	Battery positioned low and central. Liquid cooling channels designed around the spine geometry. Canadian winter ambient air is a thermal asset.
Torque Vectoring	Suspension Geometry	Torque vectoring adjusts per-wheel power in real time. Suspension must not resist or fight the torque inputs.	Double wishbone pullrod selected for predictable compliance under asymmetric torque loading. Geometry tuned alongside VCU maps.
Brake-by-Wire	Regenerative Braking	Mechanical braking and regen braking must blend seamlessly. Any jolt at the transition destroys driver confidence and lap time.	VCU controls both simultaneously. The blend algorithm is a primary Takaya-owned IP asset worth \$2M-\$10M per OEM deal.
Active Aerodynamics	Ride Height System	Downforce load changes the load on the suspension. Ride height changes the aerodynamic behaviour. Both affect the other constantly.	Active aero and active suspension must communicate through the VCU in real time. Treated as one integrated system, not two.
V12 ICE	Rear E-Motor	ICE provides sustained high-speed power. Rear motor fills the gaps: low RPM torque, gear shift transitions, and regen.	VCU torque map coordinates both systems. No driver input required to blend them. The transition is seamless by software design.
Cooling System	Intake Architecture	Cooling radiators and engine intake both compete for the same airflow path through the body structure.	Intake and cooling channels designed as one integrated airflow system. Not two separate problems with one shared space.
Carbon Monocoque	All Subframes	The monocoque is the fixed reference datum for every other system's mounting geometry and load path.	Front and rear subframes bolt to the tub. Any change to a mounting point ripples through every connected system.

Every subsystem relationship is a design decision.

Ignoring it produces conflict. Resolving it intentionally is what system architecture means.

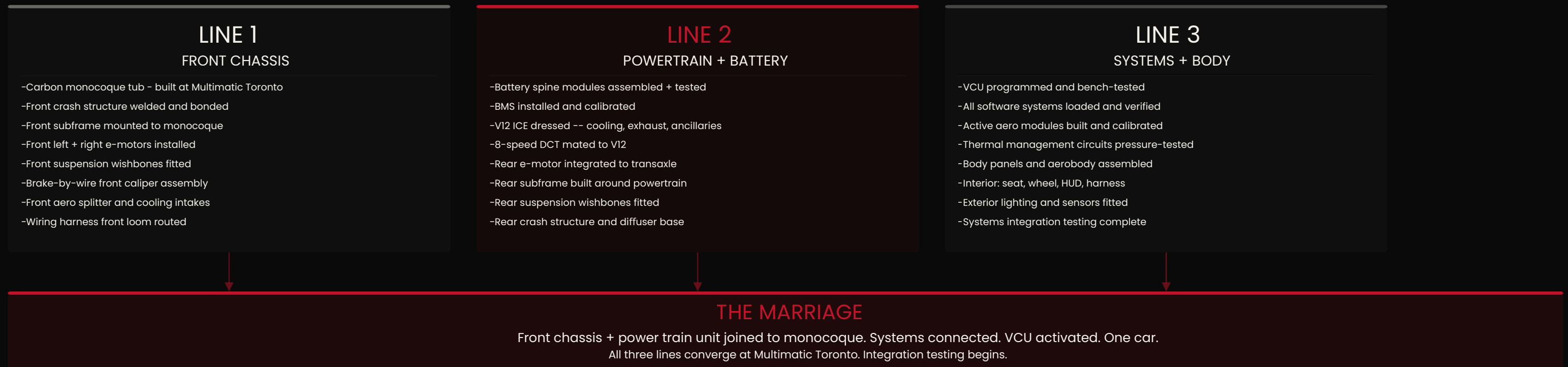
The Three-Line Build Philosophy.

Three lines build simultaneously. One marriage brings them together.

Traditional automotive assembly runs on a single sequential line – one car moves through every station from front to back. This works at volume.

At hypercar volume – 20 to 30 units per year – a different philosophy is possible. Koenigsegg, Pagani, and Multimatic all use parallel build lines that converge.

Takaya adopts this directly. Three lines build simultaneously. They meet at the marriage.



The Marriage.

The moment three independent build lines become one car.

In precision automotive manufacturing, the marriage is the moment when the major structural and powertrain assemblies are joined to the body. Koenigsegg calls this the most critical moment in the build process. Every preceding decision geometry, tolerance, interface, clearance -- **is either confirmed or exposed at the marriage.**

The Koenigsegg Parallel

At Koenigsegg in Angelholm, Sweden, three parallel build lines converge at the marriage point. Line 1 builds the carbon tub. Line 2 builds the powertrain. Line 3 builds the body. When all three are ready simultaneously the marriage is performed by hand. **The result is a car assembled with aerospace-level precision at a fraction of OEM cost.**

HOW TAKAYA ADOPTS THIS PHILOSOPHY

01 Line 1 Complete

Front chassis with monocoque, front subframe, front e-motors, suspension, and brake-by-wire. Fully wired and pressure-tested. Waiting for marriage.

02 Line 2 Complete

Powertrain unit: V12 mated to 8-speed DCT, rear e-motor on transaxle, battery spine assembled and BMS-calibrated. Rear subframe dressed and ready.

03 Line 3 Complete

All systems pre-loaded and bench-tested: VCU programmed, active aero calibrated, thermal loops sealed, interior fitted. Body panels and exterior complete.

04 Pre-Marriage Check

All three assemblies are dimensionally verified against the monocoque datum. Every mounting point is checked before the first bolt is placed.

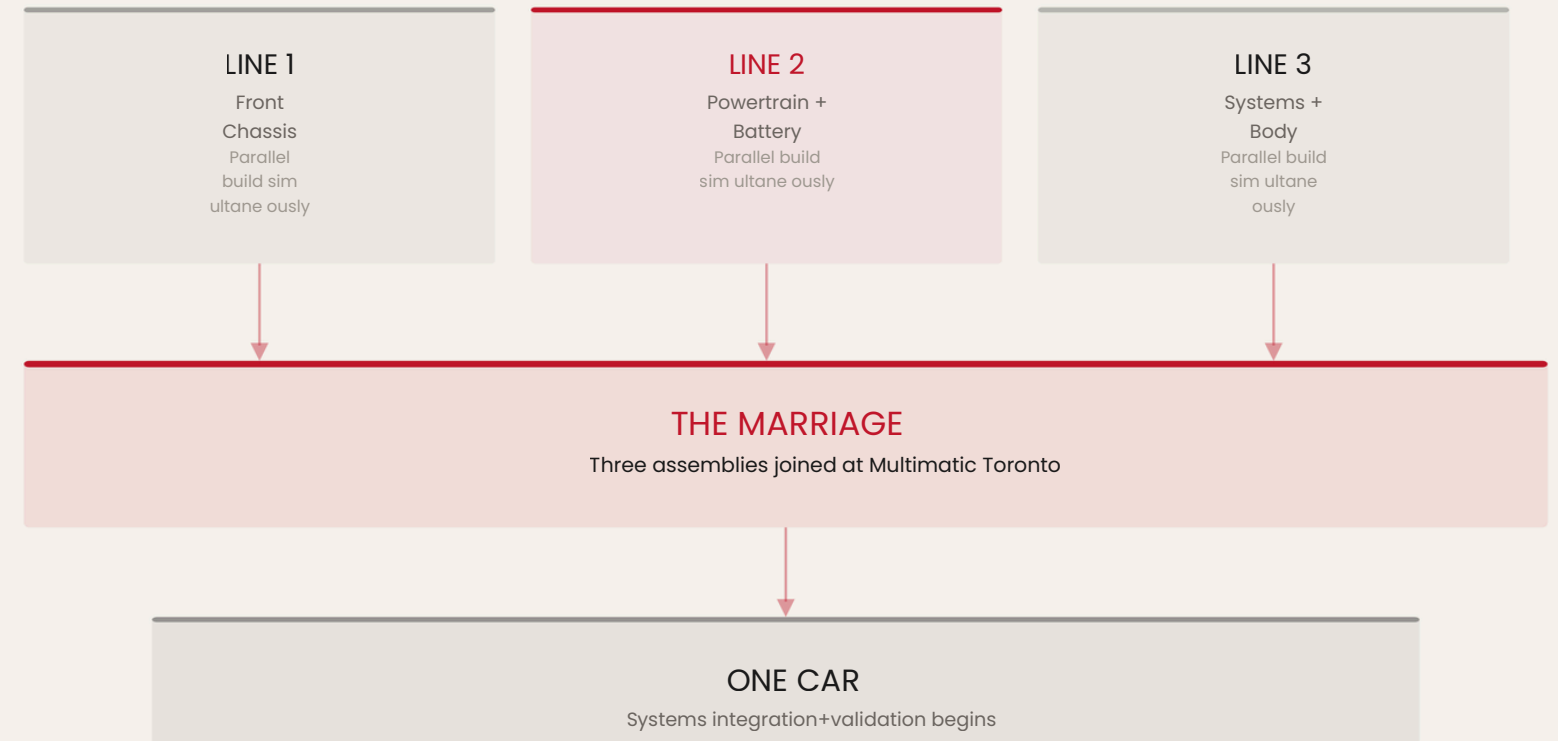
05 The Marriage

Powertrain unit is lifted and mated to the monocoque from below. Front chassis is joined. All electrical and fluid connections made. VCU activated.

06 Post-Marriage Validation

Full vehicle systems test: all 12 crates communicating. VCU reads all sensors. Torque vectoring validated on bench. Braking system bled and tested.

MARRIAGE DIAGRAM



WHY THIS MODEL WORKS FOR TAKAYA

-No single factory required -- three lines run at supplier facilities

-Parallel build reduces total build time per vehicle significantly

-Each line can be quality-controlled independently before marriage

-Supplier expertise remains at the specialist level -- no dilution

-Crate model maps directly to build lines -- one crate per line station

-Marriage is performed at Multimatic -- existing hypercar assembly capability

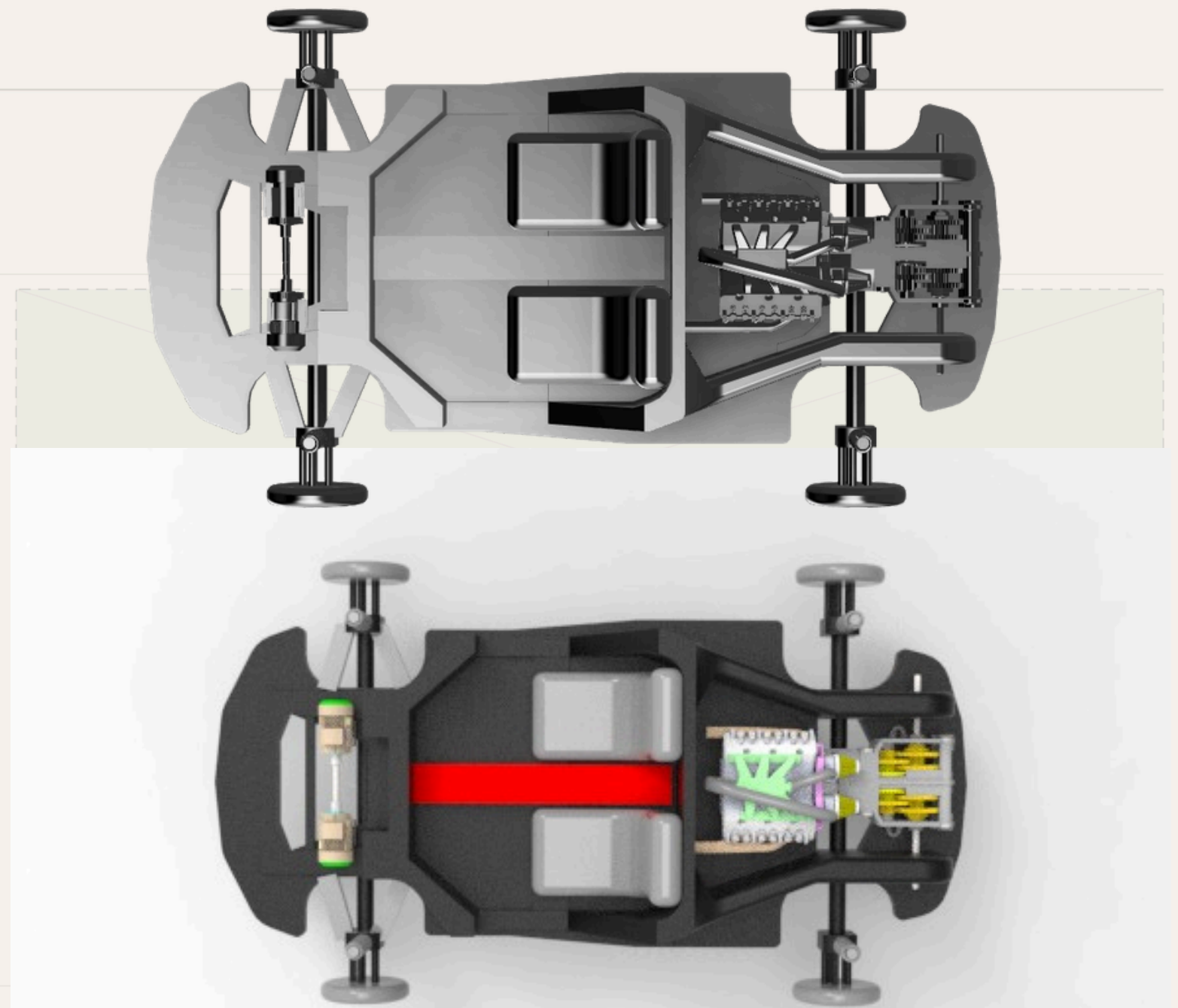
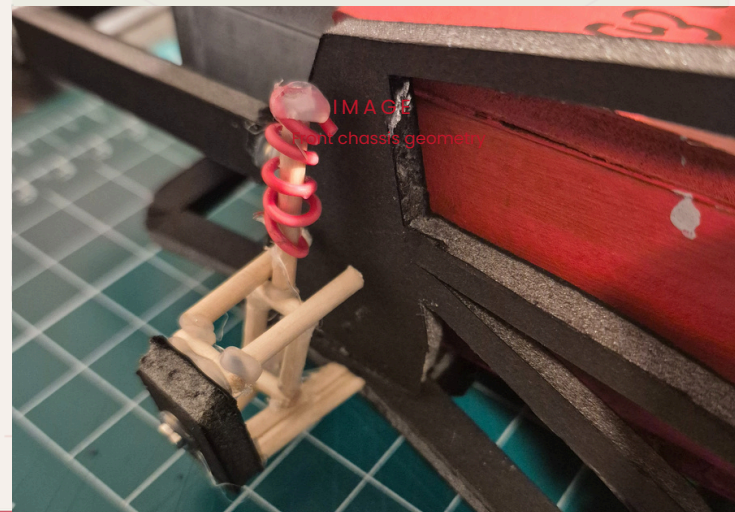
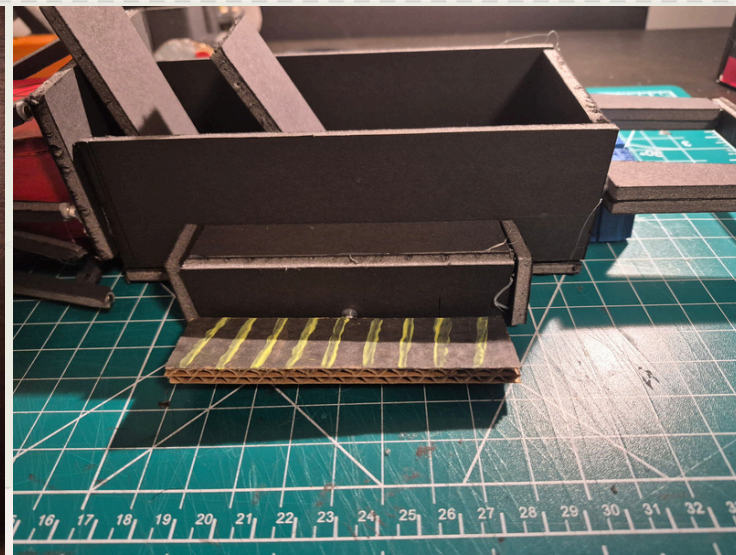
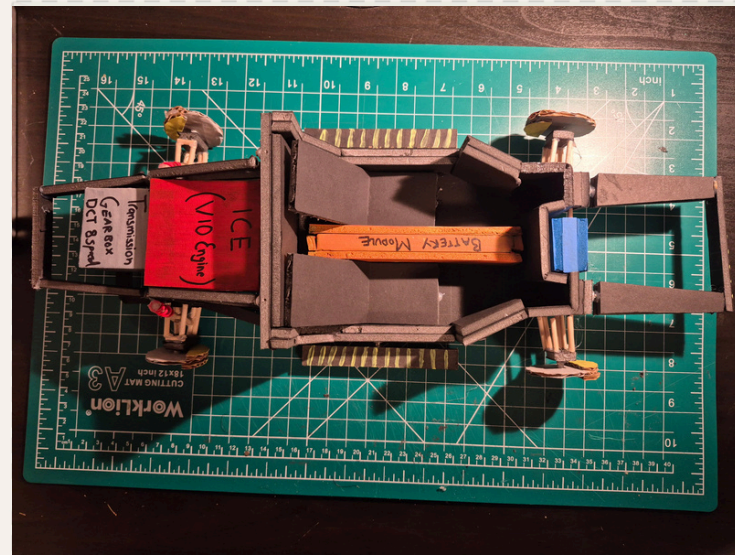
Takaya does not need to build a factory.

It needs to choreograph three parallel lines into a single moment of marriage.

Physical Prototype.

Low-to-medium fidelity. Real scale. Real packaging. Real decisions.

The physical prototype is not a styling model. It is an architecture validation tool. It confirms that 12 subsystems can coexist at the dimensions required, that the driver fits, that cooling paths are achievable, and that **the proportions emerging from the engineering are the proportions of the car.**



Packaging Validation.

Seating. CoG. Human factors. The car around the driver.

Two seating configurations were studied before the layout was decided. Both have aerodynamic and structural implications.

The decision was not arbitrary it was driven by CoG, aero, and market positioning.

SEATING LAYOUT DECISION

Side-by-Side Seating (2 seats)

Allows a wider cabin, which increases frontal area and slightly raises drag, but improves practicality and weight distribution across the car. This layout is more road-friendly and easier to integrate with standard doors, controls, and safety systems.

Implication: wider body, more frontal drag, better passenger experience.
ROAD-BIASED

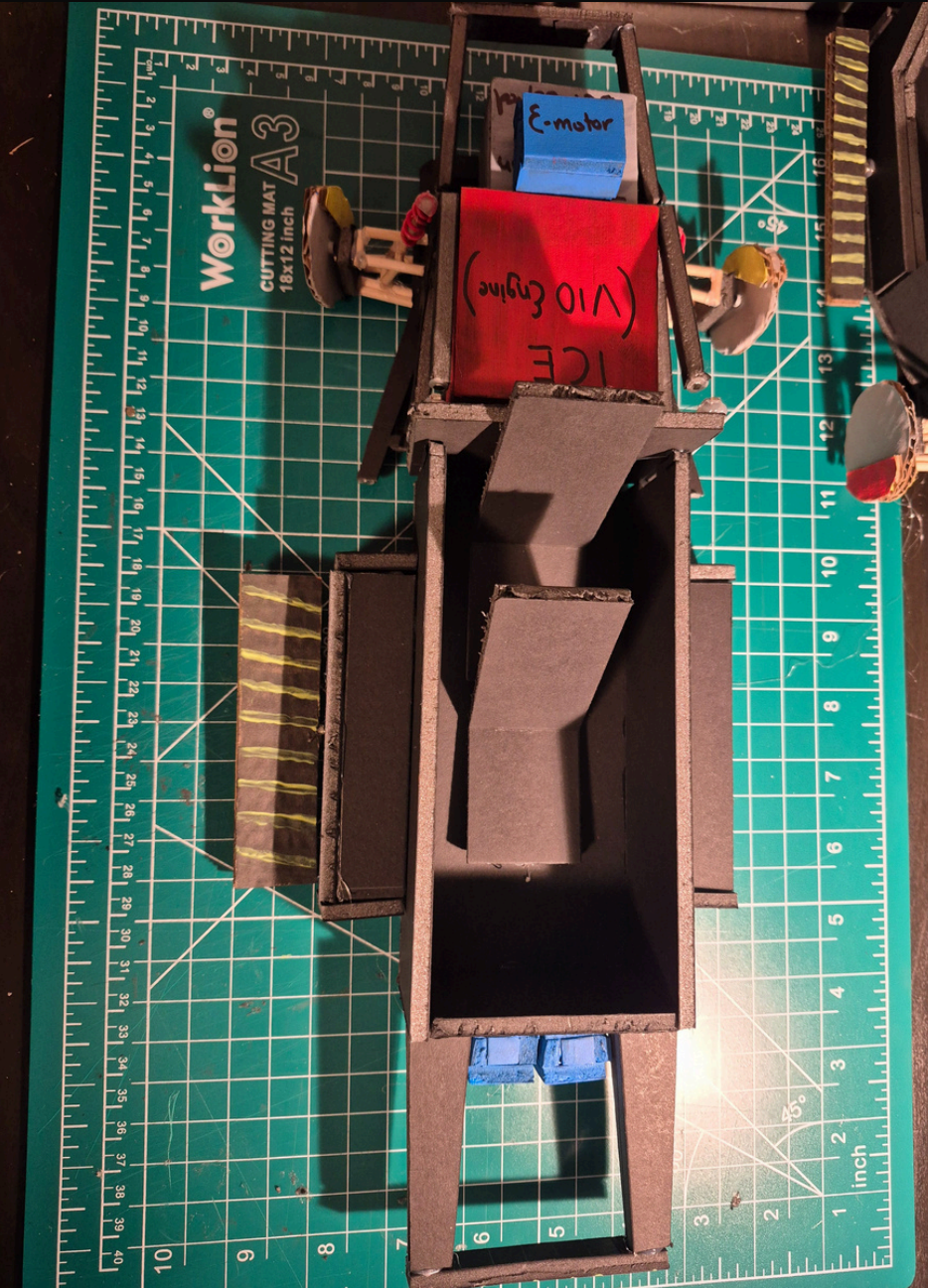
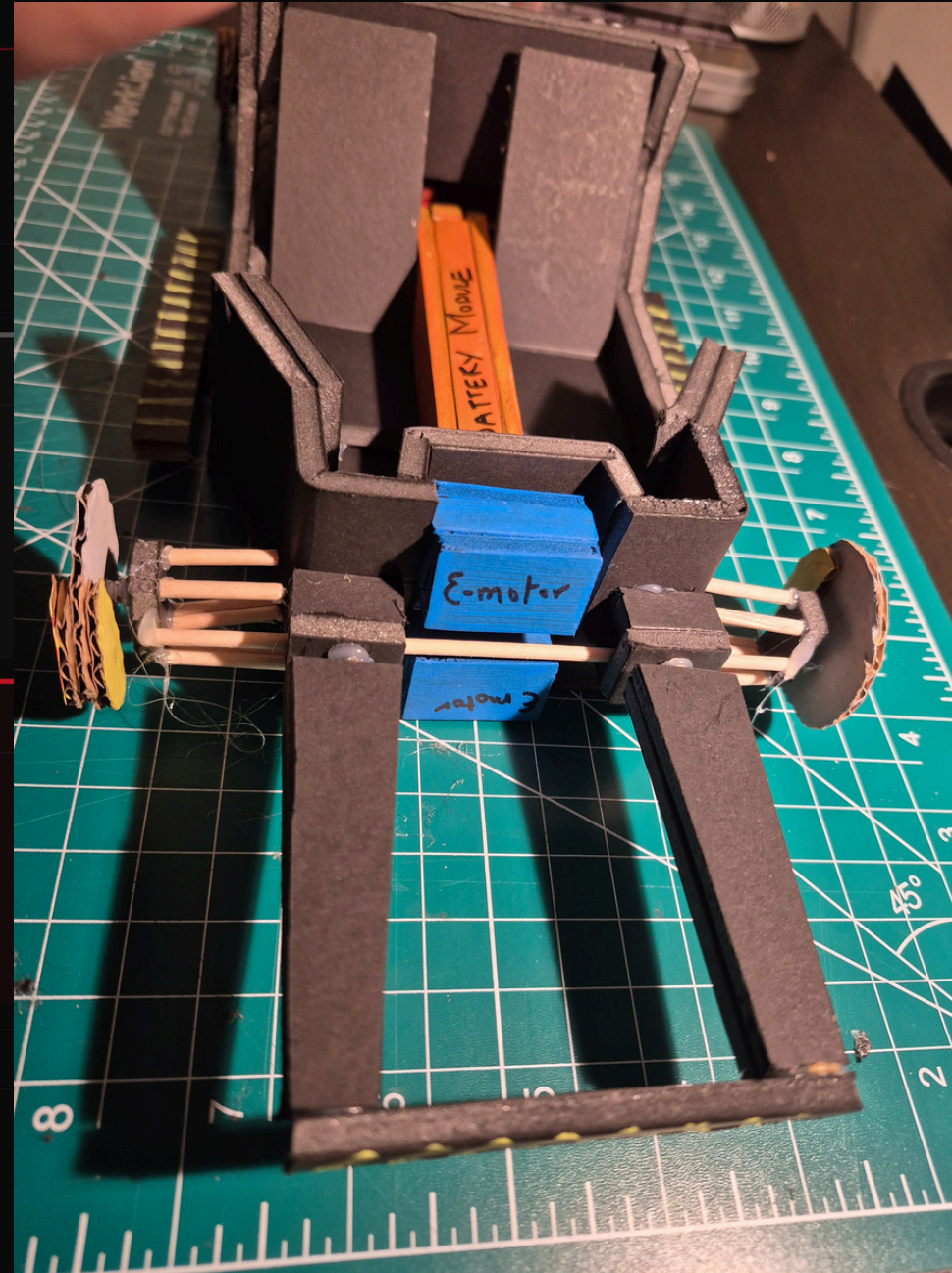
Tandem Seating (1+1)

Places passengers in line, significantly narrowing the cockpit and reducing frontal area, which improves aerodynamic efficiency and airflow management. This layout favours extreme performance and allows cleaner body surfaces, but reduces accessibility and everyday usability.

Implication: narrower body, improved aero, more aggressive character.

CENTRE OF GRAVITY + HUMAN FACTORS

- Driver hip point: as low and as central as the monocoque allows
- Pedal box forward to push driver mass toward 50/50 longitudinal balance
- Battery spine below driver seat, CoG below 300mm from ground target
- Reclined seating angle improves high-G tolerance and reduces frontal area
- Helmet clearance maintained for two drivers across 5th to 95th percentile



Form follows function follows physics.

The architecture established the constraints.

This chapter documents how those constraints produced the form.

Every proportion decision responds to a packaging requirement.

Every surface responds to an aerodynamic intent.

The sketches are not exploration. They are translation.

Alongside system architecture, the project also explores design and visual identity. The vehicle's form is developed in parallel with its technical layout, ensuring proportions, stance, and surface language reflect performance intent *rather than decorative styling.*

WHAT THIS CHAPTER COVERS

P.76 - Vehicle Proportions + Stance - architecture defines the silhouette

P.77 - Aerodynamic Intent - downforce, drag, airflow logic

P.78 - Canadian Design Identity - what Takaya looks like as a Canadian car

P.79 - Early Sketches + Ideation - hand drawings and concept exploration

P.80 - Design Development - form refinement from sketch to model

P.81 - Early Renders - digital visualization of the architecture

P.82 - Architecture-Driven Form - how every surface decision has a reason

Proportions + Stance.

Architecture defines the silhouette. Engineering defines the stance.

In a hypercar, proportions are not a styling choice.

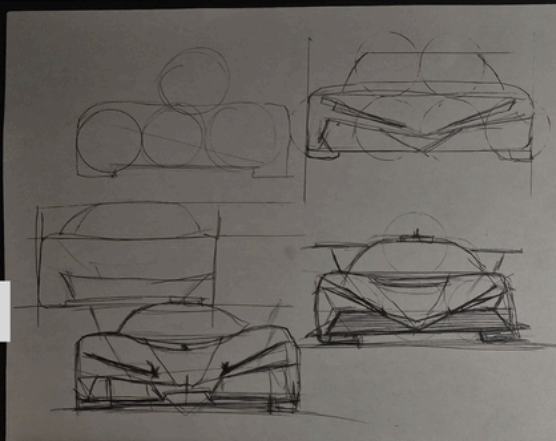
They are the visible consequence of packaging decisions made in the architecture. The wheelbase emerges from the mid-engine layout and seating position.

The ride height emerges from the ground-effect targets and CoG requirements. **The roofline emerges from the tandem seating geometry and helmet clearance.**

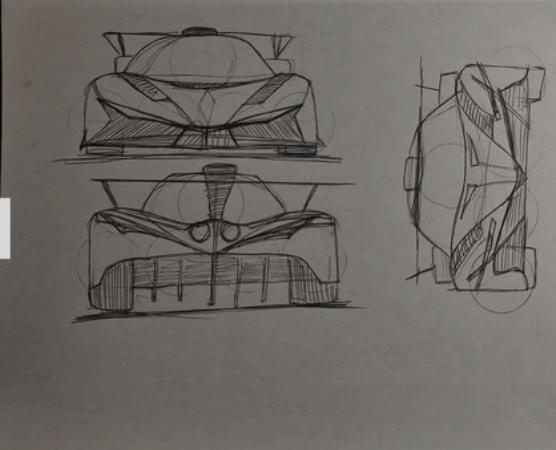
ARCHITECTURE-DRIVEN PROPORTION DECISIONS

Wheelbase Mid-engine V12 and DCT require this minimum to maintain 50/50 weight	4,200mm target
Track Width Three-motor layout and double wishbone geometry set the track. Wider front track	1,900mm front / 1,860mm rear
Ride Height Active suspension drops to 80mm for track use. Road mode at 140mm maintains ground	80mm track / 140mm road
Roofline Height Tandem seating and F1-style reclined position allows the lowest possible	1,060mm at peak
Rear Overhang Transaxle position and rear crash structure set the overhang. Active	310mm
Overall Length All subsystems packaged within this length. Every millimetre is determined by	4,520mm

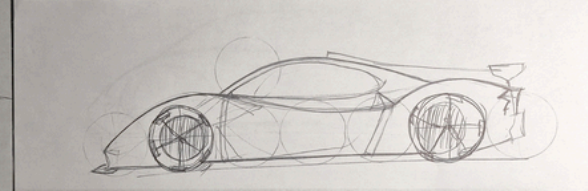
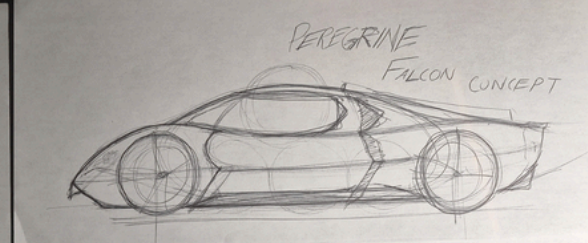
First Iteration



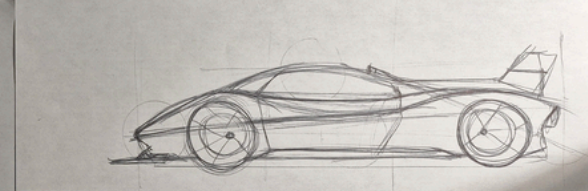
Second Iteration



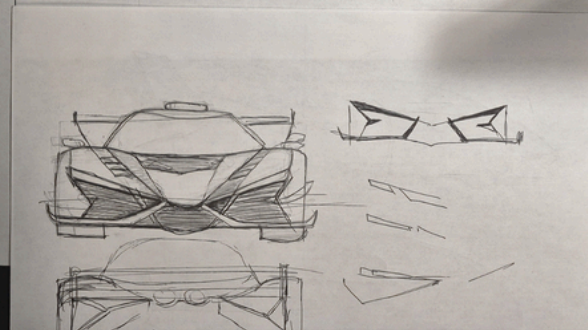
Silhouette inspired by peregrine falcon, worlds fastest species predominantly from Canada



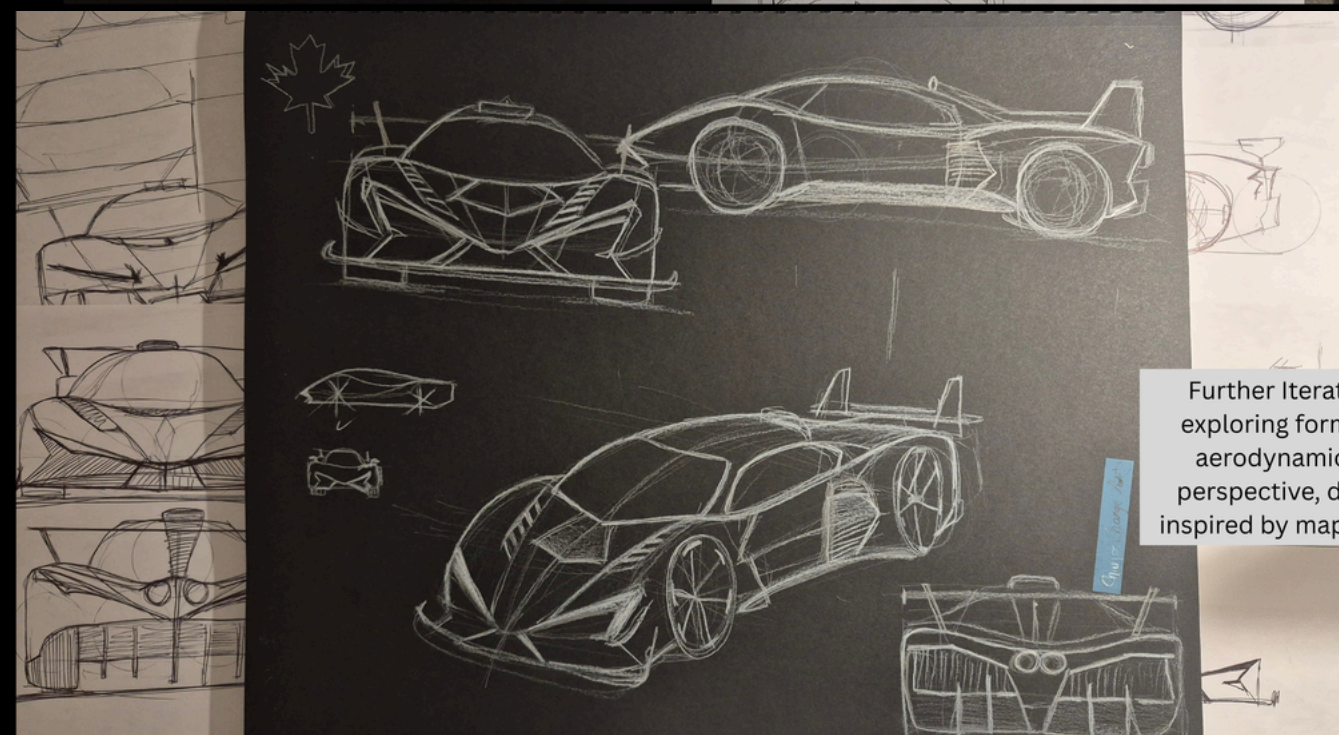
Silhouette inspired by avro canada cf-105 arrow, Canadas greatest engineering product. Which vanished in thin air, because of foreign influence



Third Iteration



Further Iteration , exploring form and aerodynamics in perspective, details inspired by maple leaf



Aerodynamic Intent.

Downforce. Drag. Airflow. Every surface has a job.

Aerodynamics are responsible for generating downforce, reducing drag, and maintaining stability during braking, cornering, and acceleration. They work directly with suspension behaviour, torque vectoring, and the VCU to keep the car balanced at high speed.

AERODYNAMIC SYSTEMS

Front Splitter

Generates front-axle downforce. Manages airflow separation at the nose. Feeds the underfloor venturi

Venturi Tunnels

Ground-effect channels under the car. Primary downforce generator. More efficient than wings at high speed.

Active Rear Wing

Multi-element wing. DRS-capable. VCU-controlled. Deploys full angle under cornering.

Active Diffuser

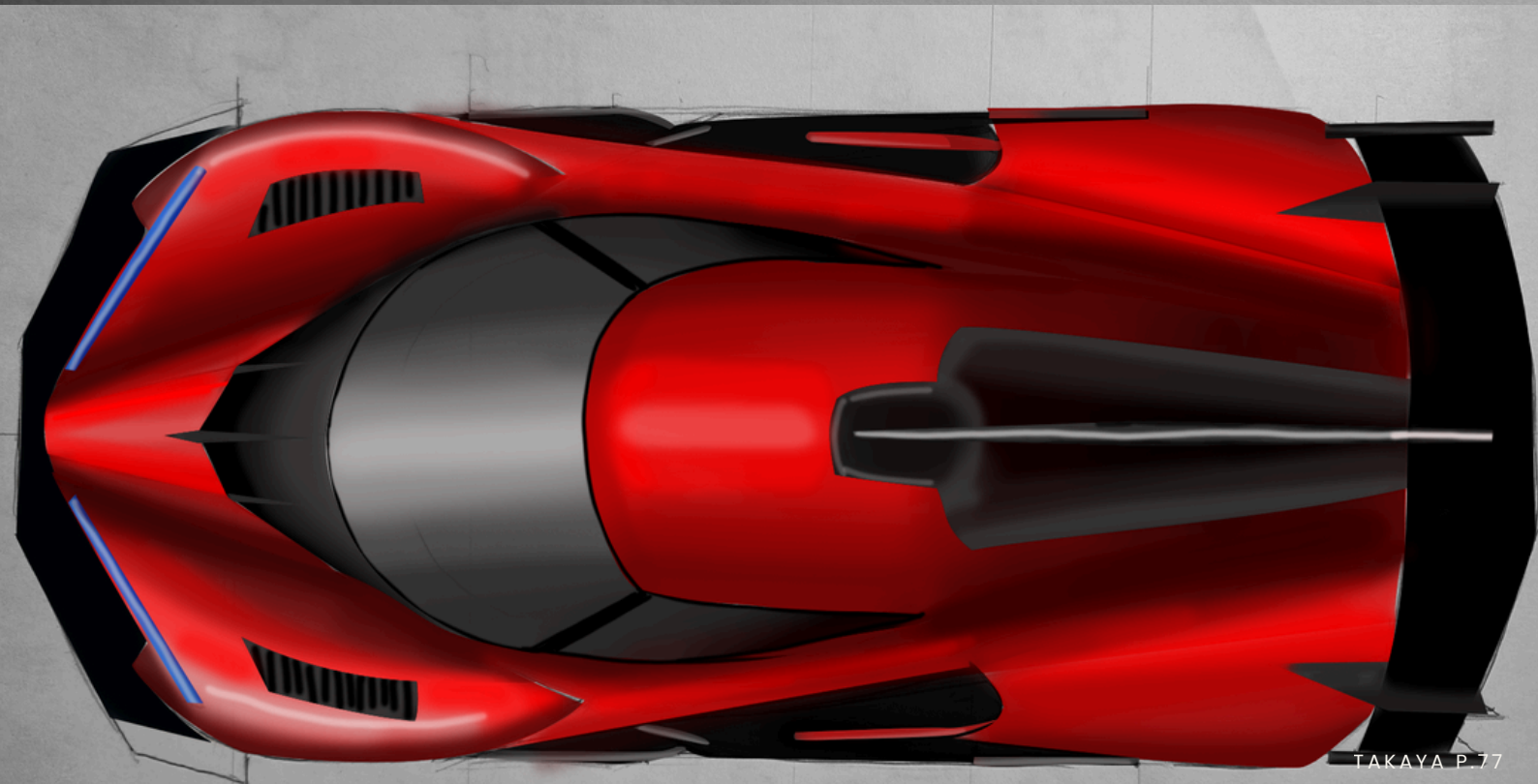
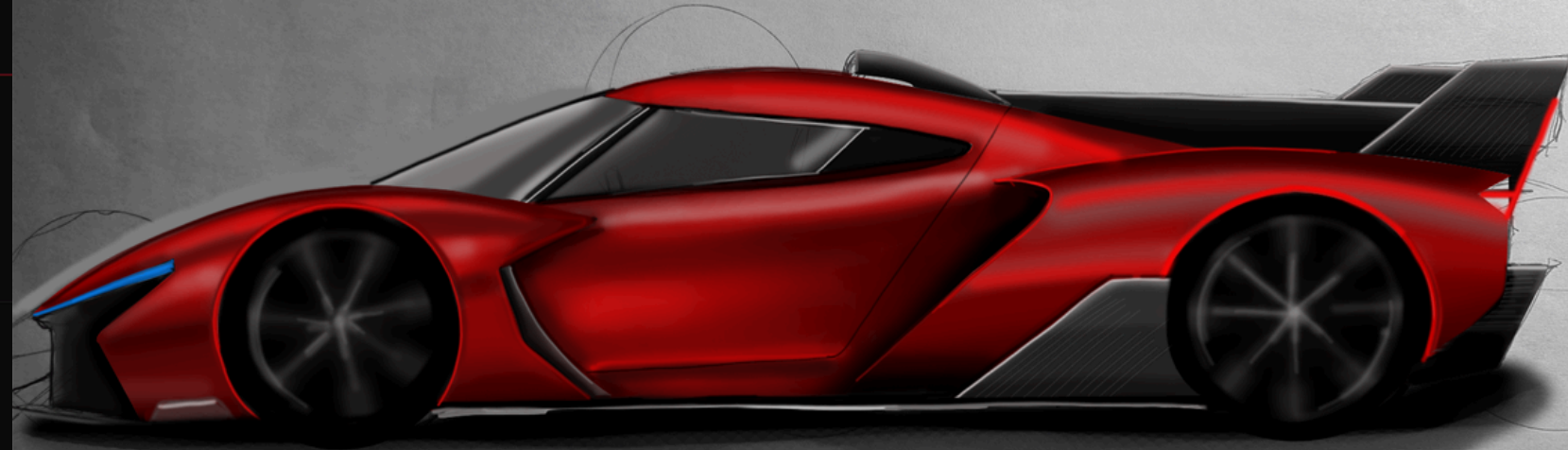
Rear under floor extraction. Works with venturi tunnels to maintain suction at the rear axle under all

Side Intake Architecture

Air intake channels supply V12 and cool the battery and power electronics. Designed as one integrated airflow.

Cooling Exits

Managed exhaust of thermal airflow over the rear deck. Positioned to avoid creating lift or turbulence at the



Canadian Design Identity.

Not borrowed from Italy. Not copied from Germany. Built from here.

Canada has no automotive heritage to reference and no design language to inherit from a predecessor. For most nations, this would be a weakness.

For Takaya, it is the foundation of the identity.

THREE PILLARS OF TAKAYA'S DESIGN IDENTITY

The Wolf - Takaya

- Takaya is an Inuktitut word meaning wolf. The wolf
- resilient, adaptive, built for extreme conditions
- is the most honest symbol for a Canadian

The wolf is not borrowed iconography. It is a Canadian archetype. Strength through adaptation.

The Landscape

Canadian design identity draws from the landscape: vast, sparse, extreme, and beautiful under pressure.

The car's surfaces do not compete with its

Unnecessary ornament. Every surface has a function. That restraint is the identity.

The Arctic Falcon

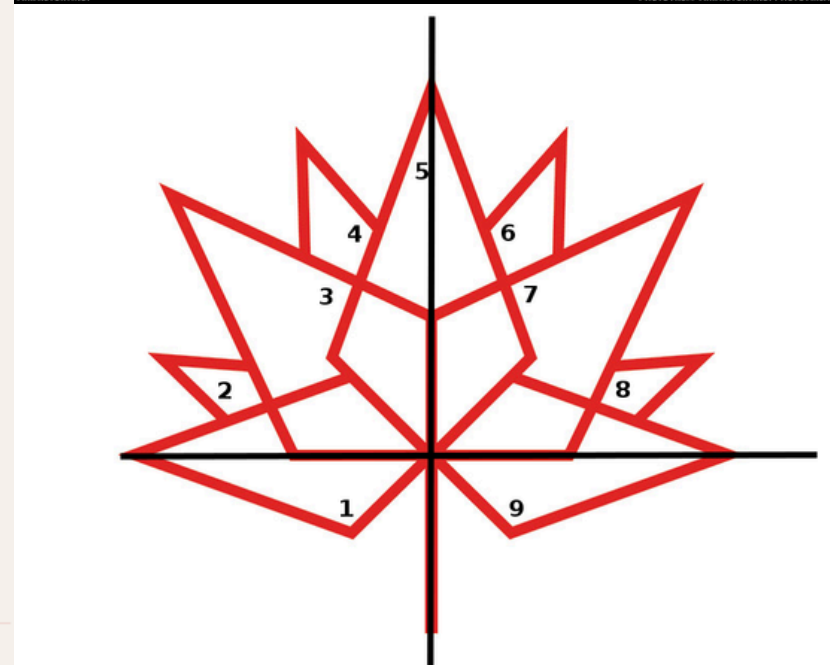
The Peregrine Falcon - the fastest animal on earth, native to the Canadian Arctic - informs the aerodynamic language.

The front splitter reads as a

Speed through form. Efficiency through precision. Character through restraint.

Italy is Ferrari. Germany is Porsche. The US is Corvette.

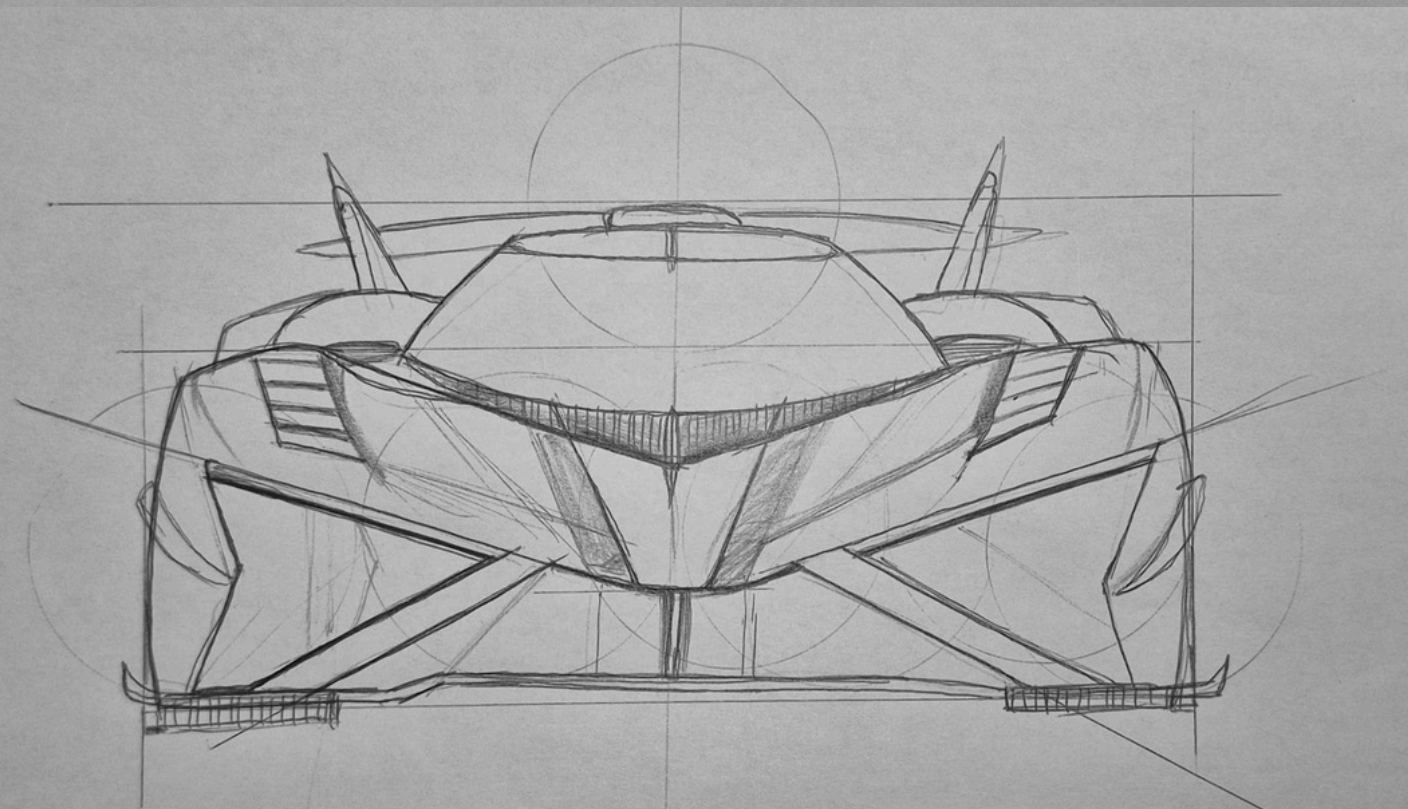
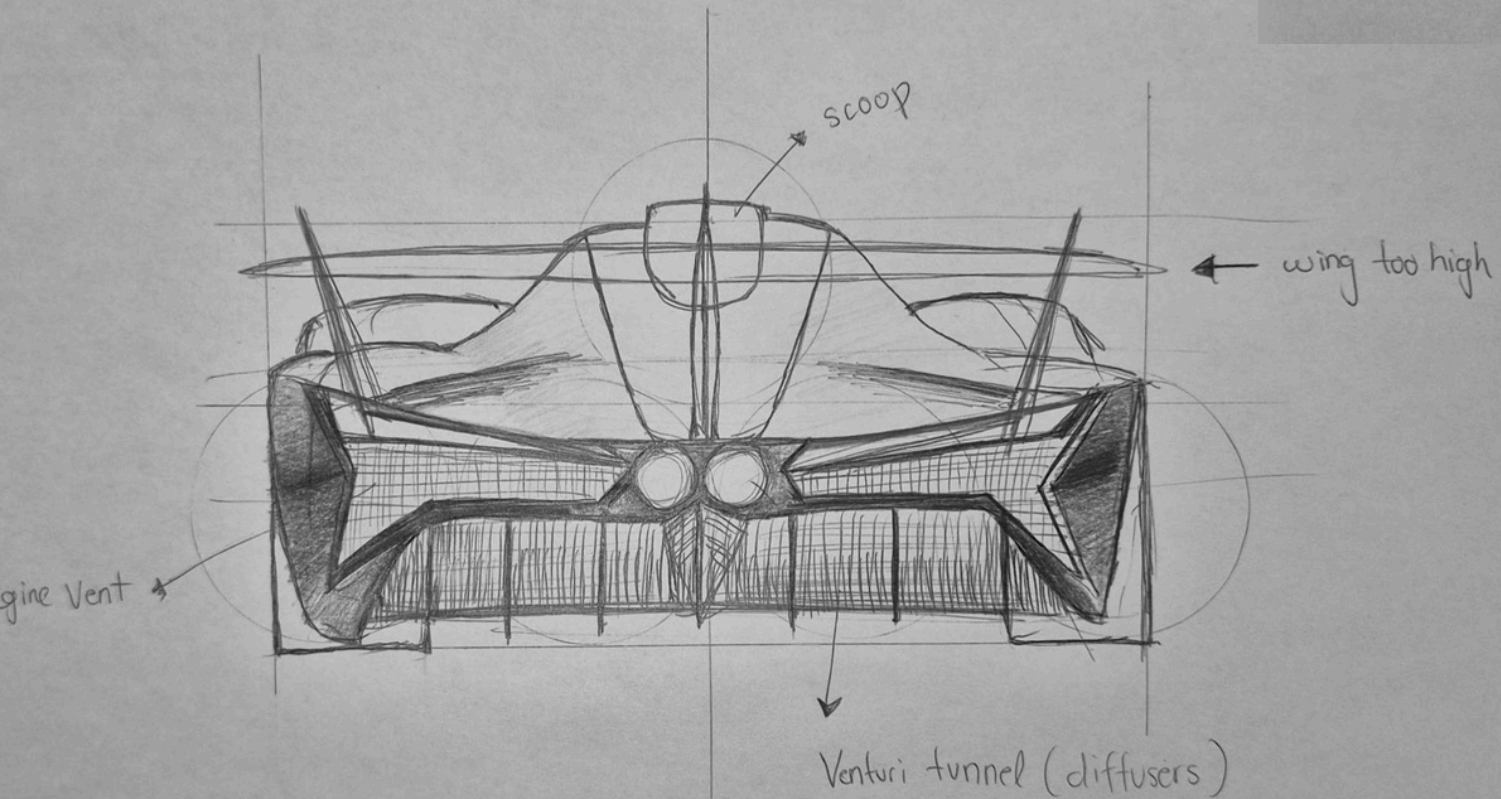
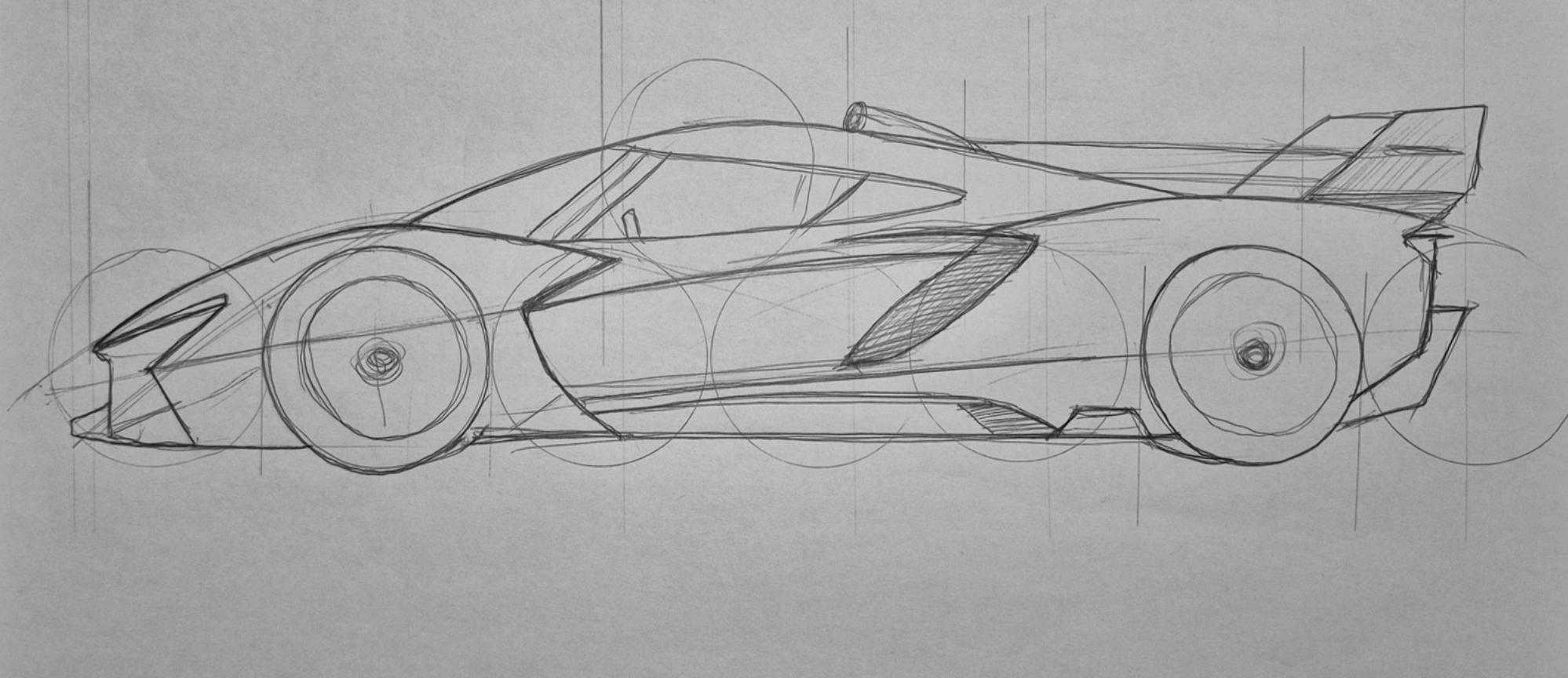
Canada is Takaya. The wolf. The falcon. The land.



Early Sketches.

Ideation + Exploration.

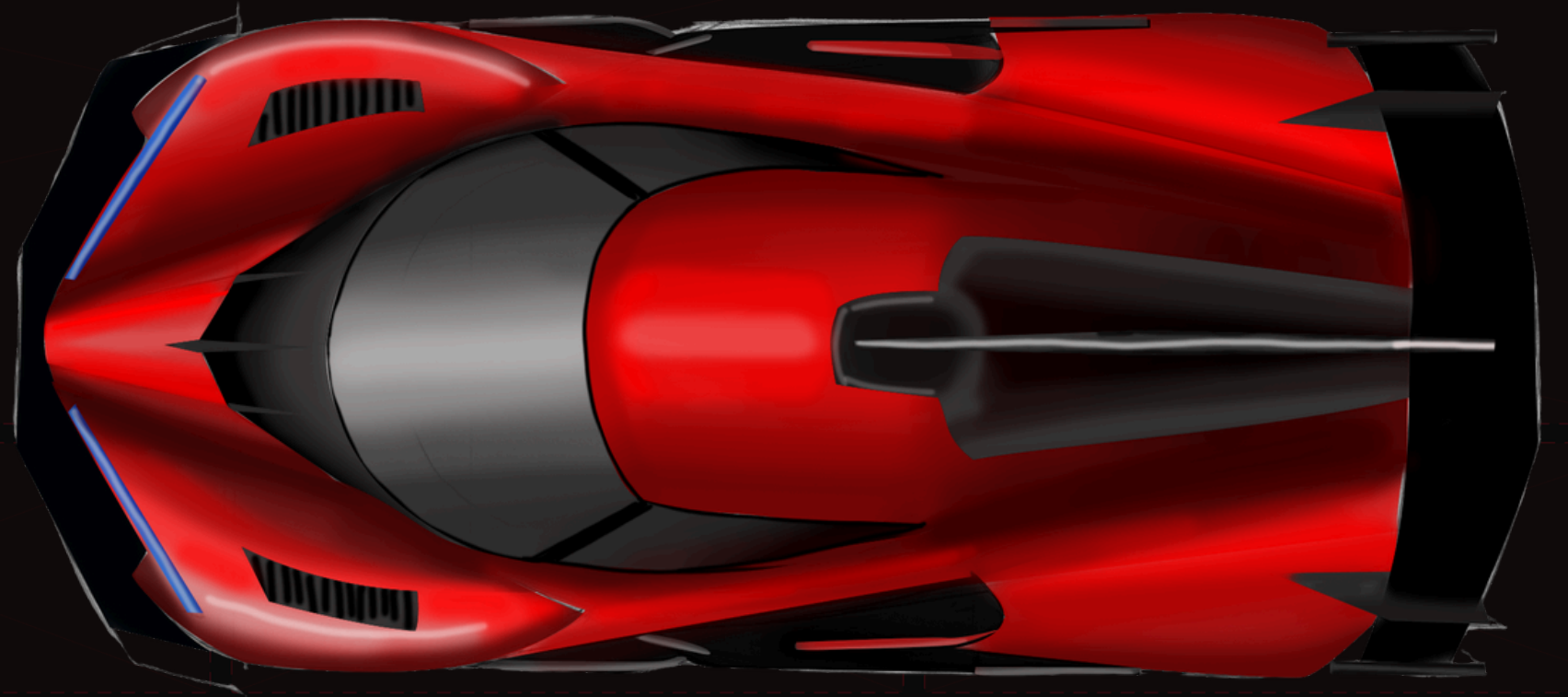
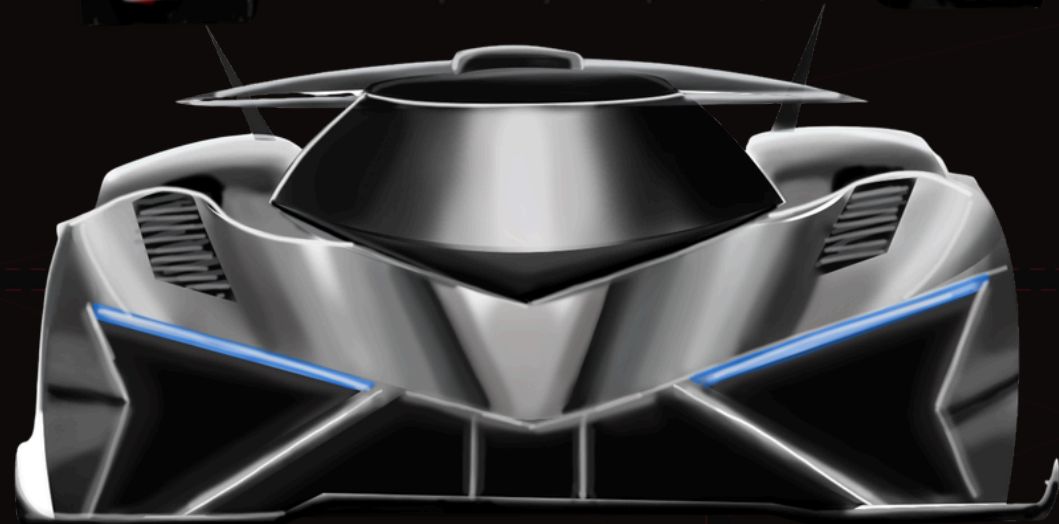
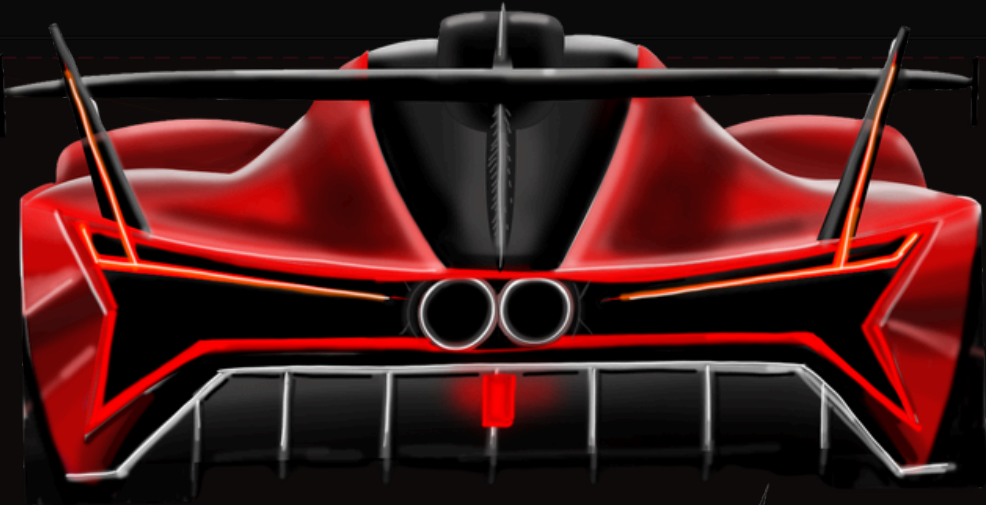
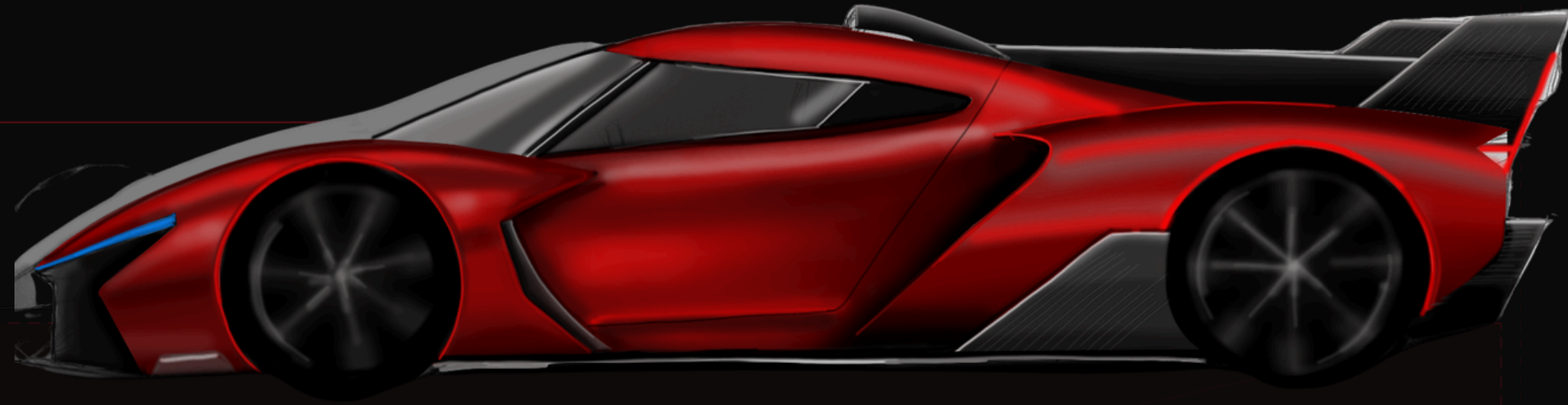
Hand drawings. Line studies. The search for the right language.



Early Renders.

Digital painting of a physical architecture.

The render confirmed which surfaces were right and which required revision.



Every Surface Has a Reason.

Architecture-driven form. Engineering made visible.

This page maps the most visible design features back to their engineering origin. Every surface that appears as a styling decision is in fact an architecture decision.

This is what separates Takaya's design philosophy from decoration.

DESIGN FEATURE	LOOKS LIKE	ENGINEERING ORIGIN	SYSTEM
Low nose Aggressive, predatory stance	Ground-effect intake geometry and downforce balance		Aerodynamics
Wide rear haunches Muscular, planted proportion	Rear track width from torque vectoring layout and rear motor package		E-Motor + Suspension
Narrow cockpit Aggressive, purposeful	Tandem seating reduces frontal area for aerodynamic efficiency		Packaging + Aero
Side pod form Purposeful intake geometry	V12 intake + battery cooling + power electronics thermal path		Cooling + Aero
Long rear diffuser Clean, functional tail	Venturi tunnel extraction requires minimum 380mm of exit length		Aerodynamics
Flush body surfaces Clean, taut skin	No panel gaps that could disrupt laminar airflow below 250km/h		Aerodynamics
Active wing visible Technical, honest	Structural requirement - passive wings cannot achieve target downforce		Aerodynamics
Low roofline Sleek, fast profile	F1-style reclined driver position and helmet clearance geometry		Human Factors
Exposed mechanical elements Raw, honest	Cooling and structural elements serve aero + thermal functions		Thermal + Structure

Future-Ready Architecture.

The crate model does not need to be replaced. It needs to be upgraded.

The most valuable architectural decision in this project is not a specific component.

It is the principle that every subsystem is replaceable without rebuilding the vehicle. **This is future-proofing by architecture, not by specification.**

UPGRADE SCENARIOS-CRATE REPLACEMENT

Battery Crate Generation 2

Current: High-discharge NMC lithium-ion cells. Future: Solid-state battery crate.

Same dimensions, same interfaces, same mounting points. Battery energy density doubles. Thermal management simplified. Range and performance

No changes to monocoque, cooling circuit, or VCU. Crate swapped. Performance upgraded.

Powertrain Crate Generation 2

Current: V12 hybrid with external sourced engine. Future: Canadian-developed hybrid engine as IP matures. Alternatively: full-electric powertrain crate as V12 becomes culturally complete. Same rear subframe. Same transaxle

The V12 era concludes. The electric era begins. The car does not change.

Software Crate Continuous

Current: VCU version 1.0. Future: AI-trained predictive torque management drawing from accumulated fleet telemetry. The software crate is upgraded over-the-air. No physical change to the vehicle. Every car in the fleet gets better

OTA updates mean the car on the road today performs better than it did the day it was delivered.

Aero Crate Performance Track Variant

Current: road-legal active aero package. Future: competition-specification aero crate with full ground-effect venturi tunnels and adjustable front-rear balance. Same body attachment points. Increased downforce. Track-only certification.

The same car with a different aero crate is a different performance product entirely.

The crate model is the most important design decision in this project.

It means Takaya does not become obsolete. It becomes more capable.

Advanced Materials.

What the next crate generation is made of.

The current architecture uses proven materials: carbon fibre, aluminium alloys, titanium fasteners, NMC lithium-ion cells, and standard power electronics.

The crate model means each of these can be upgraded crate by crate as advanced materials become commercially available.

Solid-State Battery

Target: Battery Crate Gen 2

Higher energy density. No liquid electrolyte. Safer thermal profile.

Faster charge cycles. Enables lighter battery spine

Silicon Carbide Power Electronics

Target: Software +E-Drive Crate

SiC inverters are more efficient, run cooler, and are smaller than silicon. Enables higher switching frequencies and

Graphene Composite

Target: StructuralCrate Gen 2

10x stronger than steel at a fraction of the mass. Graphene-enhanced carbon fibre reduces monocoque mass by 15-25% without dimensional

Aerogel Thermal Insulation

Target: ThermalCrate Gen 2

Ultra-low conductivity insulation for battery thermal management. Reduces thermal management system mass significantly.

Additive Titanium

Target: Suspension +Chassis

3D-printed titanium uprights, brackets, and suspension nodes.

Complex geometry impossible with machining. Mass reduced

Bio-Based Carbon Fibre

Target: Aero +Body Crate

Carbon fibre derived from bio-sources instead of petroleum. Equivalent structural performance. Canadian forestry industry

Canada is the world's second largest lithium reserve holder -- next-generation battery cells

-- Canadian forestry provides bio-based carbon fibre feedstock -- structural IP opportunity

-- NRC materials research programs already active in graphene and advanced composites

-- Ontario and Quebec mining provides titanium and rare earth elements for advanced alloys

-- Canadian universities lead in battery chemistry research -- direct IP co-development pipeline

Advanced materials do not require a new car. They require a new crate. That is the architecture advantage.

Differentiation.

What makes Takaya irreplaceable. What no competitor can copy.

Every hypercar has a unique performance claim. Koenigsegg owns top speed. Rimac owns EV performance. Pagani owns craftsmanship. McLaren owns F1 heritage. Takaya's irreplaceable claim is Canadian cold-weather validated performance **combined with a licensable national IP platform no other OEM controls.**

Cold-Weather Validated

No other hypercar in the world is designed, built, and validated in -30C to +40C operating conditions. This is Canada's unique environmental differentiator. Every Takaya

This is not a marketing claim. It is a genuine engineering qualification no European competitor can replicate without building infrastructure in Canada.

Canadian Identity

Cars from countries without a heritage are rare. Canada's absence of automotive legacy is the differentiator. Takaya does not reference anyone else's design language. It defines its own. That

The Inuktitut name. The wolf. The Arctic Falcon. The maple leaf. None of these references are available to any competitor. They are exclusively Canadian.

National IP Platform

Takaya does not just produce a car. It produces a licensable control architecture -VCU, torque vectoring, brake-by-wire, thermal management that any OEM can license. This software layer is

No other hypercar brand operates simultaneously as a vehicle manufacturer, software company, and IP licensing platform. Takaya does all three.

The Crate Ecosystem

The crate model can be licensed to EV startups, defence contractors, and fleet operators globally. No competitor offers this. Takaya's business model extends far beyond selling cars.

Rimac licenses software. Takaya licenses both software and the physical crate architecture. The scope of the IP platform is larger than any single competitor.

Platform Evolution. Generation 2. And beyond.

The hypercar is not the ceiling. It is the proof of concept for a platform that can expand into every segment where performance, IP, and identity converge. Each expansion reuses the crate architecture. The IP compounds. The brand grows.



The Takaya platform does not end with the hypercar.

The hypercar is the opening statement of a platform that Canada will own permanently.

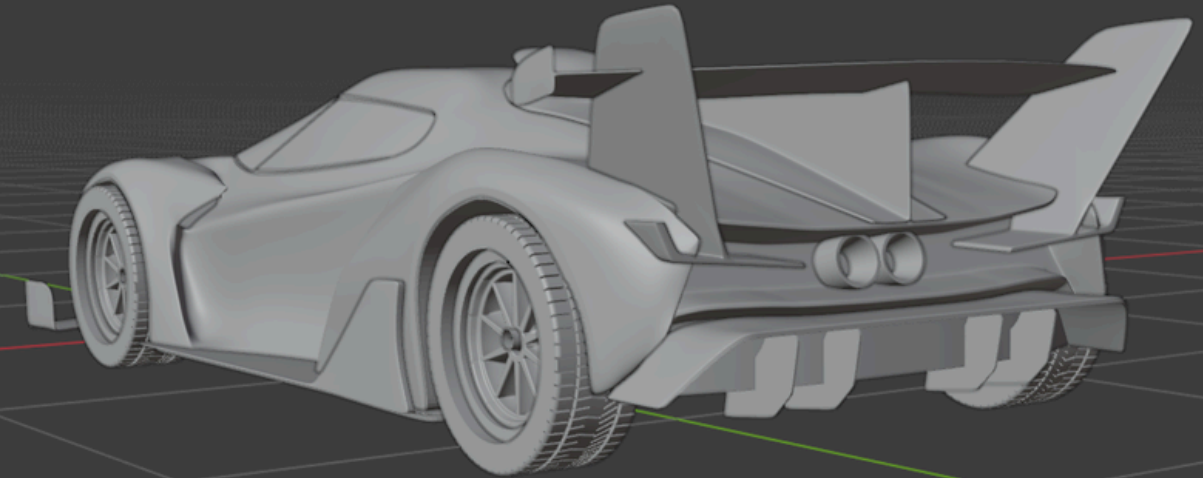
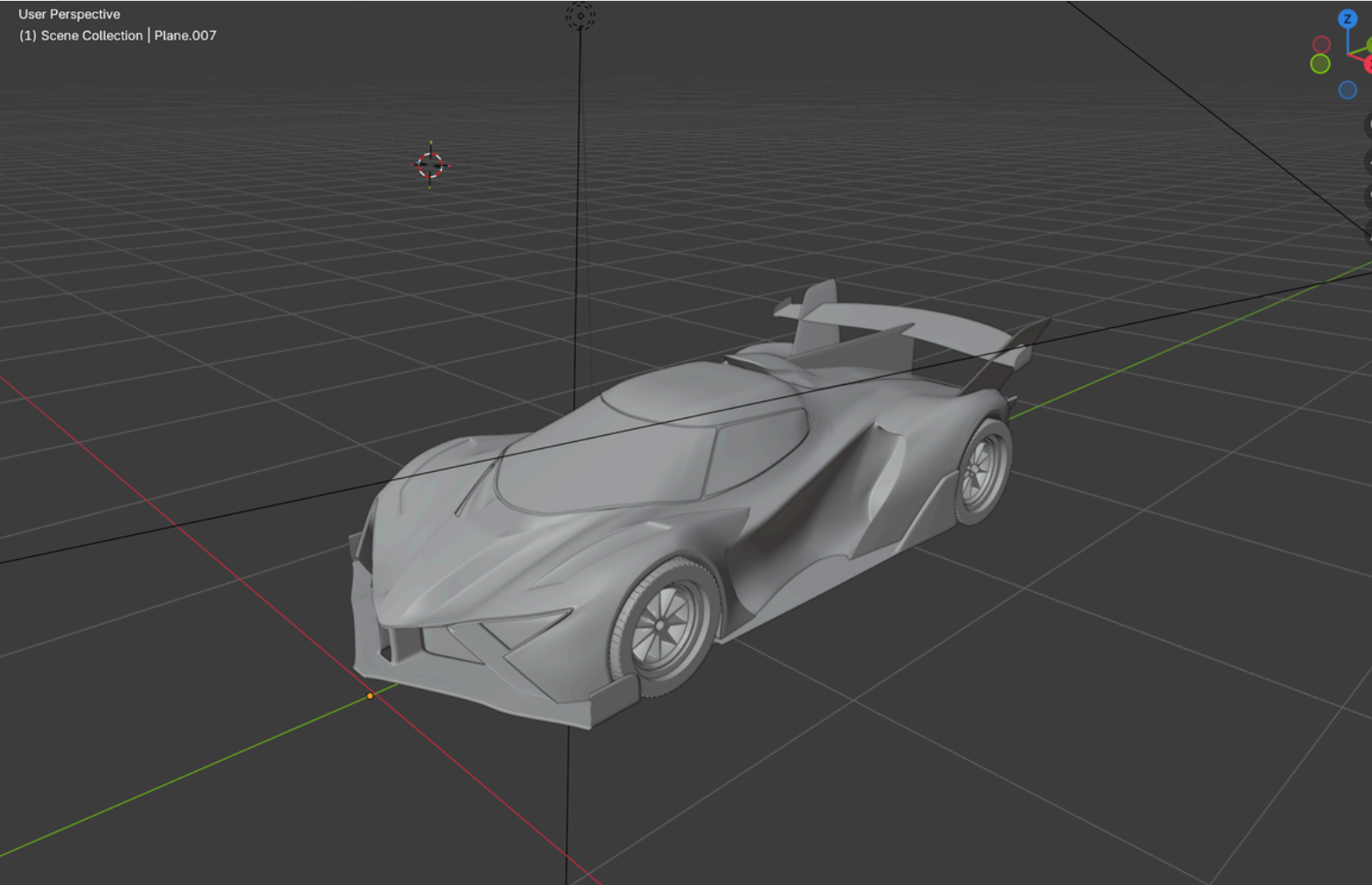
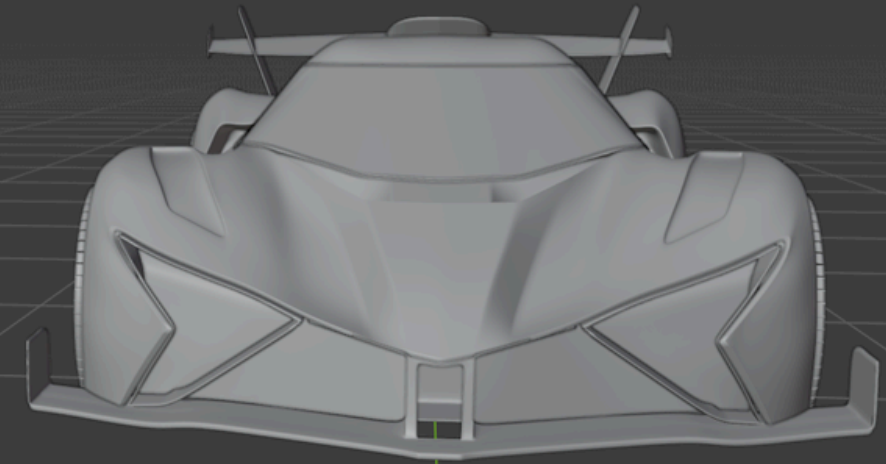
Every unit sold, every drive cycle completed, every licensing deal signed makes the platform more valuable.

Final Prototype.

The integrated system. Every decision made physical.

The final prototype is a physical scale model integrating system architecture, aerodynamic intent, packaging validation, and Canadian design identity. It is not a concept model. It is an architecture validation model.

Every dimension responds to a subsystem requirement.



What the Prototype Proves.

12 systems. One vehicle. Clear expression of Canadian capability.

The prototype does not prove that a hypercar can be built.

That was already known. Multimatic builds them. Magna builds them.

What it proves is that a Canadian-designed architecture can unify those capabilities into a system that Canada owns, controls, and can build upon permanently.

ALL 12 SYSTEMS CONFIRMED IN PROTOTYPE

01 Carbon Monocoque

Architecture validated. All mounting points within tolerance. Torsional

02 Hybrid Architecture

Battery spine dimensions confirmed. BMS interface points correct. CoG at

03 Aerodynamics

Splitter, venturi, wing, and diffuser positions confirmed against aero

04 Cooling System

Thermal paths achievable within body volume. Radiator sizing confirmed at

05 Braking System

Front and rear caliper positions clear. BBW actuator space confirmed.

06 Steering System

Rack position and steering column angle confirmed within ergonomic

07 Suspension

Wish bone geometry confirmed. Damper inboard positions verified within

08 Control Software

VCU mounting position confirmed. All harness routing paths achievable.

09 Structural

Front and rear subframe mounting confirmed. Crash structure clearances

10 Safety System

All safety-critical system positions confirmed within safe zones.

11 Electronics

Full harness routing confirmed. No conflicts with mechanical systems.

12 Interior

Driver position confirmed. Helmet clearance achieved. Reach envelope

What this prototype demonstrates about Canadian capability:

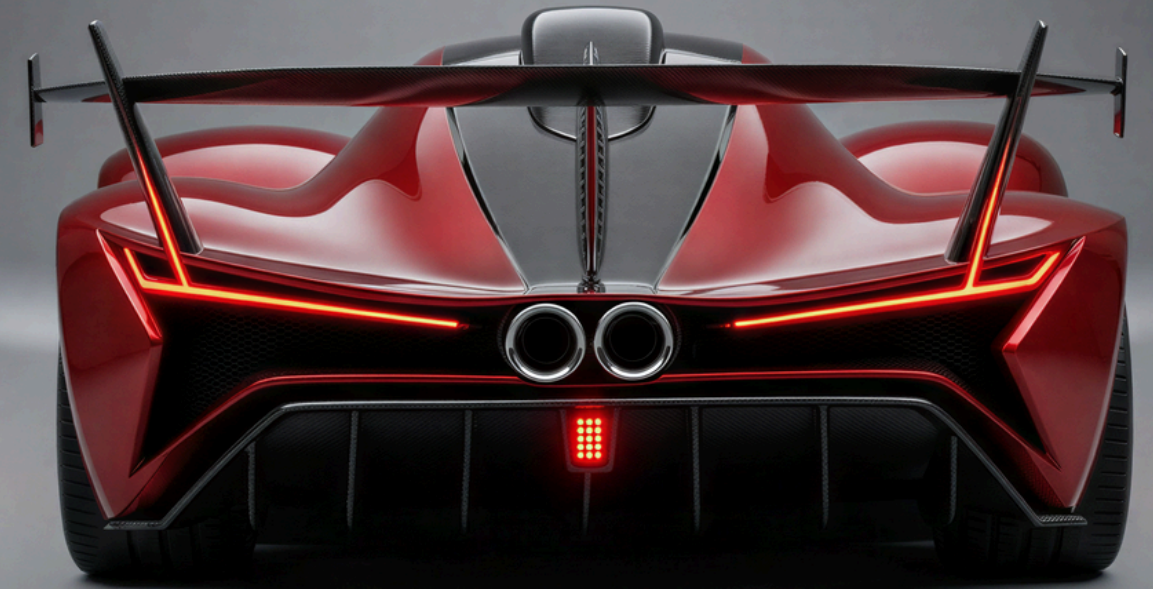
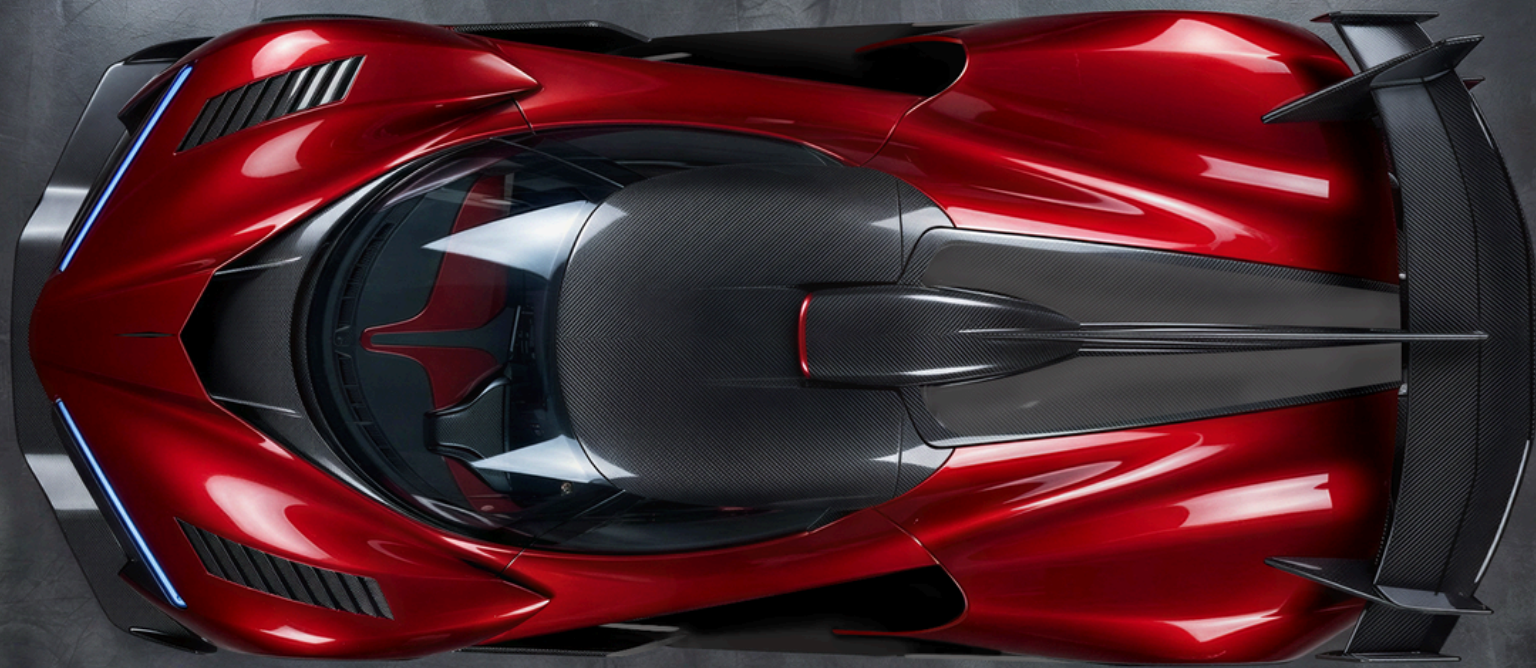
- Canada can produce a monocoque hypercar chassis through Multimatic Toronto
- Canada can package a V12 hybrid + battery spine + three-motor system within a defined architecture
- Canada can design a complete vehicle control architecture for a performance platform
- Canada can develop the integration logic that turns twelve separate subsystems into one vehicle
- Canada can define the design language, identity, and physical form of a world-class performance car

The prototype is not a prototype of the car. It is a prototype of the platform.

Final Renders.

The complete vehicle. Form and architecture unified

Vizcom renderings.



Lessons Learned.

What this project revealed. What there search confirmed. What surprised me.

Every project teaches its designer something the brief did not anticipate. These are the most important things this project taught.

The problem was never the car

I spent the first weeks trying to design a car. The actual problem was always the system that would allow a car to exist. Once I understood that, the project became coherent.

Lesson: Define the system before defining the object. The object is the proof, not the problem.

Canada's gap is structural, not technical

The research confirmed that Canada does not lack the ability to build a world-class performance vehicle. It lacks the coordination layer above its suppliers. This is not a

Lesson: Some of the most important design problems have no physical form until someone creates one.

Every subsystem interaction is a design decision

I expected the architecture to be an engineering document. It became a design document.

Every time two subsystems interacted, a decision was required about which one had

Lesson: The designer who does not understand the systems beneath the surface cannot make good decisions about the surface.

The crate model is more powerful than I anticipated

I proposed the crate model as a manufacturing strategy. It turned out to be a business

model, an IP strategy, a stakeholder alignment tool, and a future-proofing mechanism

Lesson: Modularity is not a compromise. It is the most powerful design principle in a distributed system.

Industrial design at system scale requires new methods

Industrial design education prepares designers to work at product scale. This project

required working at industrial policy scale, business model scale, and vehicle

Lesson: The discipline's boundaries are not the project's boundaries. Go where the problem leads.

The identity came last, not first

I did not design the visual identity of Takaya until I understood what Takaya was. The

wolf, the falcon, the restraint in the surfaces -- none of these emerged from a mood

Lesson: Design identity from conviction. Not from inspiration boards.

How This Project Informs Practice.

What was learned here applies beyond this project.

The methods developed in this project are transferable.

Every national industrial system that has scattered capability and no coordination layer above it is a version of the same problem. **Industrial design at system scale is the discipline that can solve it.**

SIX TRANSFERABLE PRINCIPLES

01 Map before making

Before any form decision is made, map the system the form must serve. The map is the most important design output. The object is secondary.

03 Modularity compounds

Modular systems accumulate value. Each module improves independently. Each improvement makes the whole more capable. Design for modularity always.

05 The designer is a translator

The designer's highest function in a complex project is translation: between engineering and business, between capability and strategy, between

02 Gaps are opportunities

Every identified gap in a system capability is a development target. Every target reached is an asset. Reframe limitation as roadmap.

04 Identity comes from conviction

The strongest design identities emerge from the deepest understanding of what something is for. Research the values first. Let the form follow.

06 The brief can be the design

When no brief exists, writing the brief is the first and most important design act. This project began with a question, not a commission. The

These principles apply to transportation design, urban design, policy design, healthcare systems, defence logistics, and any domain where **scattered capability exists without a coordination architecture above it.**

Designer Trajectory.

Where this project leads. What it prepares this designer for.

WHAT THIS PROJECT BUILT- SKILLS AND METHODS

System Architecture

Translating ecosystem research into a physical multi-subsystem architecture. Defining interfaces,

Stakeholder Mapping

Identifying and mapping 8 distinct stakeholder groups, their unmet needs, and the design response to each.

Business Model Design

Designing the hardware and software revenue model, the IP roadmap, the self-sustaining loop, and the platform

Design Identity

Developing a complete brand identity -- name, symbol, visual language, surface philosophy -- grounded in the

Vehicle Architecture

Understanding vehicle dynamics, packaging constraints, subsystem interactions, and manufacturing philosophy

Physical Prototyping

Building low-to-medium fidelity physical models to validate packaging, human factors, and architectural

WHERE THIS LEADS

Transportation System Design

The crate model, the three-line build philosophy, and the stakeholder mapping

Industrial Policy Design

This project demonstrated that design can operate at the level of national industrial

Platform Architecture

The Virtual OEM model -- a design-led coordination layer above scattered industrial

Automotive IP Consulting

The gap analysis, IP roadmap, and crate licensing framework are immediately applicable

Takaya -- The Next Phase

The most direct trajectory is continuing the Takaya project: building the real stakeholder
This is the intended outcome.

Canada has the capability.
Canada has the suppliers.
Canada has the engineers.
Canada has the opportunity.

Canada, it is time to build
our own automobile.

Mussawer Ahmed
Industrial Design OCAD University

Takaya 

Inuktitut. Meaning: Wolf.
Strength. Resilience. Adaptability. Built for extreme conditions.
A Canadian archetype. The right name for Canada's first performance platform.

TAKAYA