



THE LOW-VOLUME VEHICLE PRODUCTION (LVP) CHALLENGE IN NORTH AMERICA

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KEY MESSAGES

There is a strong case for low-volume models in a mature market line in North America

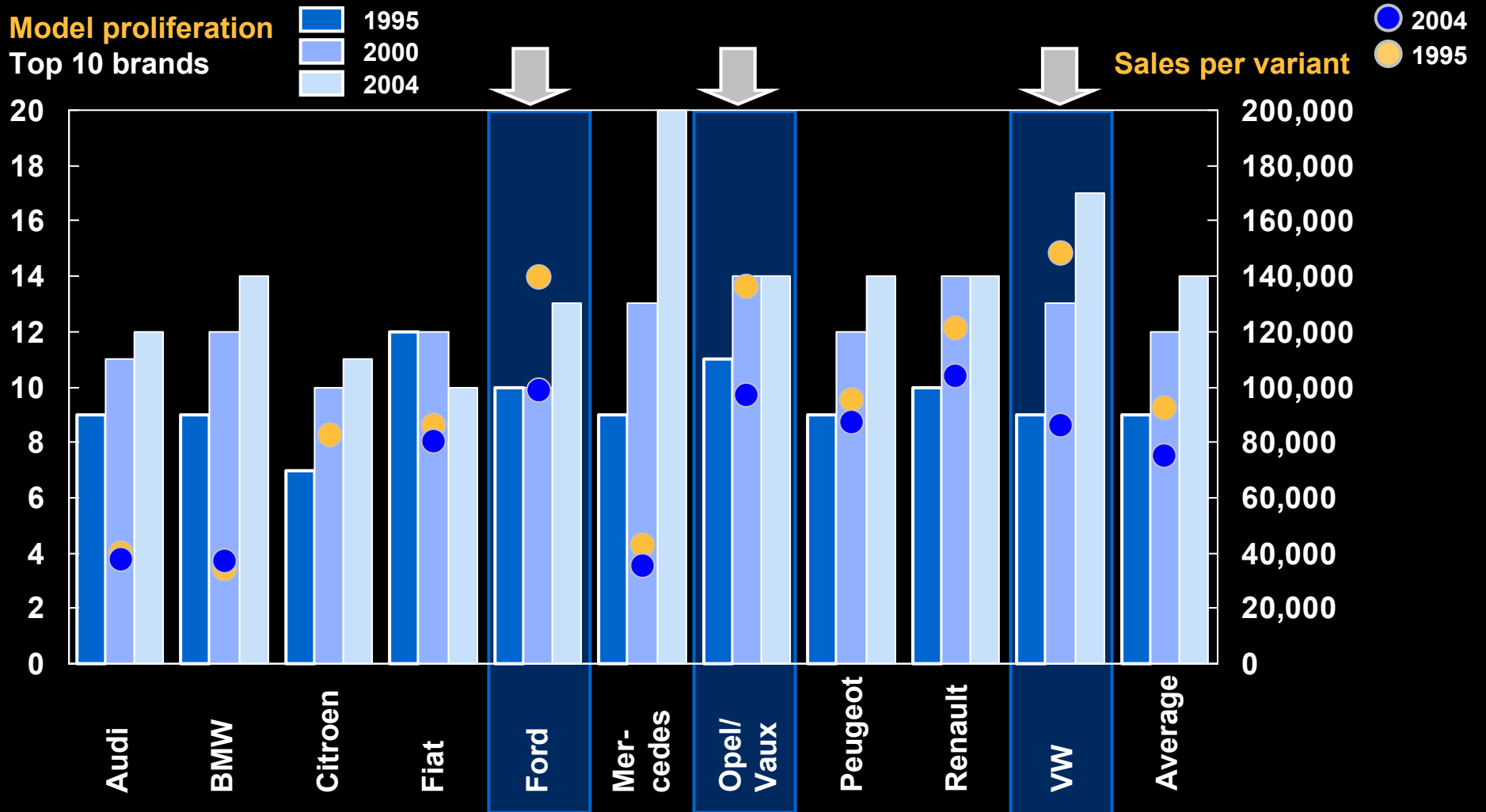
However, the North American auto industry has had mixed success with low-volume vehicle production and is searching for solutions

To overcome these challenges, the industry can explore 4 potential options

- **Complete OEM control**
- **Approved aftermarket modifications**
- **Abdication to the independent aftermarket**
- **Outside assembly/design model**

A PROLIFERATION OF MODELS AND VARIANTS IS ONE WAY OUT OF ONGOING VEHICLE COMMODITIZATION, AS SEEN IN EUROPE

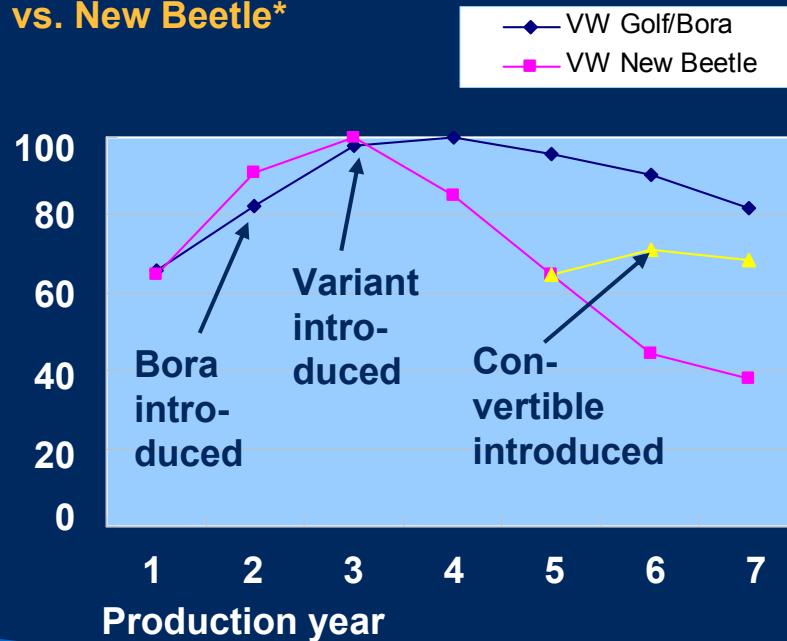
PWC AutoFacts European data – model count up, volume per model down



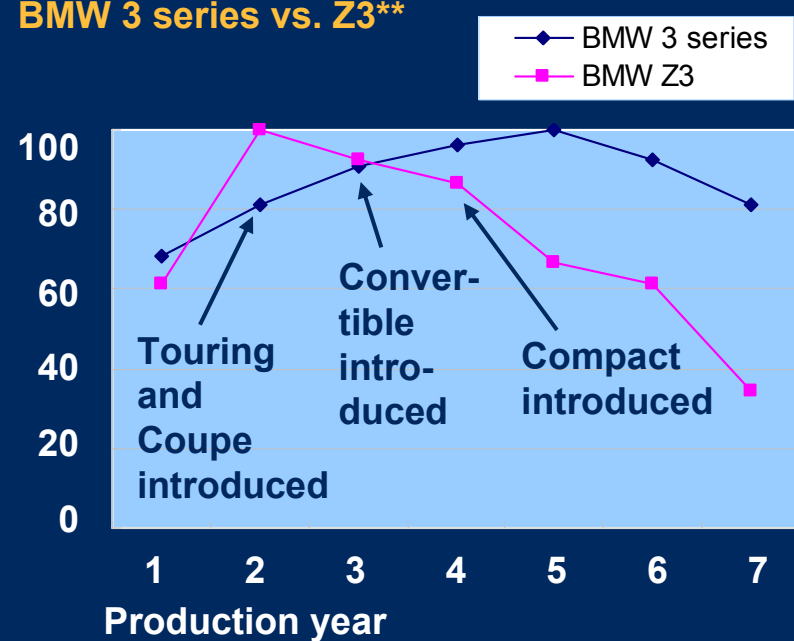
A DOWNSIDE OF NICHE MODELS IS THEIR GREATER DEMAND VOLATILITY

Percent of peak volume

Unit sales of the VW Golf vs. New Beetle*



Unit sales of the BMW 3 series vs. Z3**



- Niche models show much higher volatility in demand

* Absolute peak volume Golf/Bora 940,000 units/annum, New Beetle 105,000 units/annum

** Absolute peak volume 3 series 562,000 units/a, Z3 57,000 units/annum

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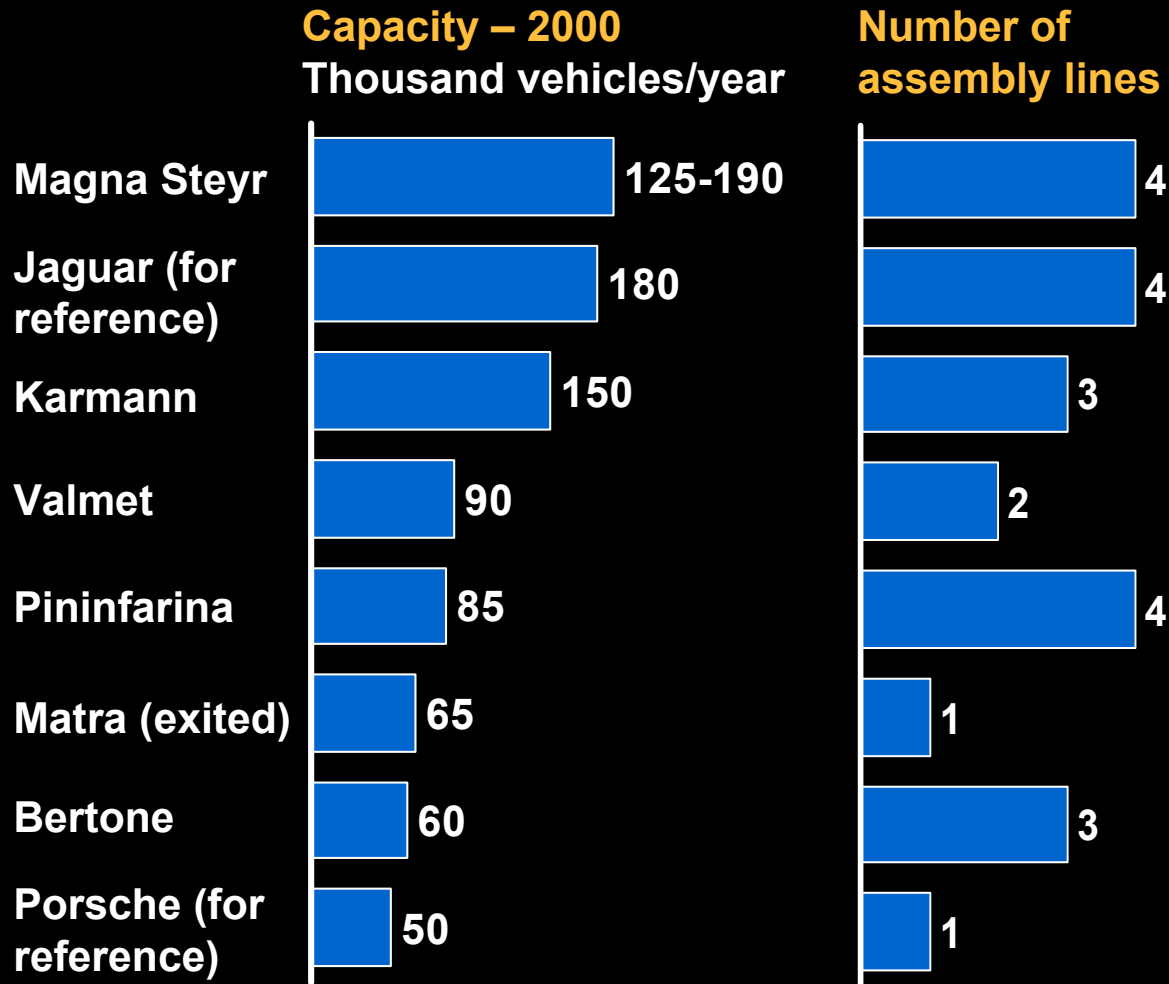
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EUROPEAN APPROACH – SMALL-SCALE ASSEMBLERS (PARTIAL LIST)



Enabling conditions

- Focus is on special niches (e.g., convertibles)
- Industrywide unions and wages lower labor resistance to concept
- Fragmented EU market allowed several nations to develop their own assemblers
- Long history and tradition of trust

JAPANESE APPROACH – MOSTLY AN IN-HOUSE SOLUTION

Japanese approach in Japan

- Captive specialist assemblers like Kanto and Central for Toyota, Nissan Shatai for Nissan

Japanese approach in North America

- The Asian auto companies have a long-standing strategy of standardized product and process design and production flexibility as a key component of their low-volume strategy
- Many body types are derivatives of other types, often encompassing a significant amount of carryover components (such as underbody)
- Derivative bodies typically have similar geometric envelopes (the body fits within the operating window of the automation process) and are compatible with a flexible manufacturing process
- All these automakers achieve body assembly flexibility through highly programmable automation (robots)

TOYOTA CASE – LVP IN NORTH AMERICA VIA ULTRA-FLEXIBLE BODY SHOPS

Flexible Body Line

FBL was introduced in 1985, reducing model launch times to nearly zero (objectives were flexibility, lean, and quick launch)

But the FBL was not designed to accommodate low-volume production, and is designed for 20,000 units per month or more

It can, however, be very effective for low-volume vehicle derivatives such as 4WD, lift back, at about 2,000/month

Global Body Line

In 1998 Toyota changed from FBL to GBL with the goals of pallet simplification, improved flexibility, and easier maintenance

Low-Volume Production

The Low-Volume Production Project Concept (V2) was launched in November 2004 in which the body was framed from the “inside out”

The modified GBL is more accommodating to lower volumes than the FBL, but is still targeted toward handling a model mix (up to 8) of derivative body styles

The Toyota body manufacturing strategy is based on body shop standardization (and consequently product design standardization)

DETROIT'S 3 TRAIL IN IN-HOUSE FLEXIBILITY

Automaker	Number of production lines	Number of lines with multiple nameplates	Volume produced on multiple nameplate lines Percent
Nissan Motors	6	5	94
Toyota Motor Co.	9	6	81
Honda Motor Co.	8	5	69
General Motors	32	15	48
Daimler Chrysler	16	5	36
Ford Motor Co.	21	5	23

- The Ford and GM approach to flexibility relies significantly on supplier coordination
- Standardized manufacturing modules (“plug and play”) are key to both
- GM has gone further with C-Flex, which replaces body-specific tooling for welding subassemblies

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4 POTENTIAL NORTH AMERICAN LVP MODELS

Degree of modification	New model	<p>Complete OEM control</p> <ul style="list-style-type: none"> • In-house • For example, V-Series, AMG, Scion <p style="text-align: right;">1</p>	<p>Outside assembly/design</p> <ul style="list-style-type: none"> • 2 paths <ul style="list-style-type: none"> – Assembly only – Design and assembly <p style="text-align: right;">4</p>
	Existing model	<p>Approved aftermarket modifications</p> <ul style="list-style-type: none"> • Special models • SEMA programs <p style="text-align: right;">2</p>	<p>Abdication to the independent aftermarket</p> <ul style="list-style-type: none"> • DIY • Speed shops • Restyling shops <p style="text-align: right;">3</p>
		High	Low
Degree of OEM control			



Model choices have different implications for

- Enabling technologies
- Low-cost tooling
- Low-investment assembly practice
- Automation flexibility
- Aftermarket customization

1. COMPLETE OEM CONTROL

Description

- Minimal third-party involvement
- Examples
 - “Tuner” lines like AMG, V-Series, SRT, M
 - Short-run models like Thunderbird
 - Scion

To thrive, you would have to believe . . .

. . . OEM in-house systems and processes (especially labor, body shop, and final assembly) become flexible enough without high-cost penalties

. . . OEMs can establish competitive cost structures

. . . OEMs conclude supply base is not mature

. . . OEM/supplier issues, such as to contracting, confidentiality, etc., cannot be resolved

2. APPROVED AFTERMARKET MODIFICATIONS

Definition

- Multiple third-party work
- Examples
 - Roush projects
 - GM ADI system
 - SEMA “outreach” programs

To thrive, you would have to believe . . .

- . . . fair margin sharing between OEMs and third-party is accepted as the norm
- . . . warranty responsibility can be clearly defined and managed
- . . . co-branding is acceptable to OEMs
- . . . distribution-related issues can be worked out (e.g., how to allocate limited supply across many dealerships)

3. “ABDICATION” TO THE INDEPENDENT AFTERMARKET

Definition

- Minimal OEM involvement
- Examples
 - DIY modifications
 - Speed shops
 - Restyling shops

To thrive, you would have to believe . . .

- . . . OEMs and OEM suppliers decide low-volume vehicles are not worth pursuing
- . . . customers prefer the greater flexibility and diversity that the aftermarket offers
- . . . other models prove too hard to implement (this model has been viable for many decades)
- . . . OEM labor argues against vehicle assembly outsourcing

4. OUTSIDE ASSEMBLY/DESIGN MODEL

Definition

- Assembly by separate firm(s), either with high engineering input (e.g., Karmann) or with less engineering input (e.g., Valmet)
- Examples
 - Chevrolet SSR
 - Numerous European programs
 -

To thrive, you would have to believe . . .

- . . . OEMs conclude advantages of third-part flexibility outweigh risks and some loss of control
- . . . 1 or more assemblers make investments “ahead of demand” to prove the concept
- . . . assemblers can make a living on contract manufacturer margins
- . . . extensive duplicate (“shadow”) engineering can be avoided
- . . . contracting arrangements can be worked out (risk/reward)
- . . . 1 assembler is allowed to do projects from multiple OEMs
- . . . enabling technologies prove feasible and low cost

Crucial – costs prove significantly lower than in-house

4. OUTSIDE ASSEMBLY/DESIGN MODEL – WHAT ARE SOURCES OF COST EDGE?

Potential sources of cost advantage in the outside assembly model

 Greatest potential

Labor

- Lower hourly wages at the assembler?
- Greater flexibility to ramp up and down head count?

Capital

- Lower capital budget due to substitution of labor for capital?

Purchased components

- Theoretically unchanged cost, since specifications and costs set by the contracting OEM?

Project risk management

- How to take advantage of lower cost at assembler without having to guarantee volumes required for its sustained viability?

Time to market

- Faster and nimbler operations

Do these pros and cons add up to an assembler cost advantage?

SUMMARY

The case for low-volume, short-lived models is a strong one, especially in a mature market like the U.S.

However, the North American auto industry has had mixed success with LVP and is searching for solutions

Four potential LVP models possible and may co-exist. Model choices will have different implications for technologies, tooling, investments in assembly, automation flexibility and after-market customization