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Telematics Industry Insights by Michael L. Sena

THE DISPATCHER

IN THIS ISSUE

THE JUNE 2023 ISSUE IN BRIEF

Talking with children and watching how they interact with each other is a good way for us older folks to understand the world as it is, rather than feeling that we have popped through a hole in the wall and are now wandering around in a strange and unfamiliar place. Here's a question from my eight-year-old great nephew: "Why did you move to Sweden, Uncle Michael?" Well, a nice man who worked for Volvo asked me to help his company make a navigation system and find the maps to make it work. "Why didn't they just ask Google?" Ahh, well, thirty years ago, when that nice man asked me to come to work for Volvo, there wasn't any Google. "Didn't someone else have maps on phones?" There weren't any mobile phones or phones in cars back then. Cars had radios. "No Skype?" There wasn't any Internet yet. "How did people find places?" Maps. Paper maps. We made them with computers by then, but they were on paper. That's what I did before I went to Sweden. Maybe your dad has a AAA TripTik he can show you. "Grandpa used them all the time," my nephew added, "but I don't think we kept any."

My great nephew was quiet for a while. I guess he was trying to imagine what it might have been like to live in those times, like I wondered as a child what it must have been like to live before there were televisions, or my father and mother wondered what it was like to live before there was electricity, or their parents tried to imagine what it was like to live before there were trains and steamships. When he finally spoke, he asked: "What are you working on now, Uncle Michael?" Mostly on cars that drive themselves, I answered. "Why don't you just ask Tesla? They already have that. Mom says our next car will be a Tesla. Maybe when you come back again we'll have one and you can see how it works."

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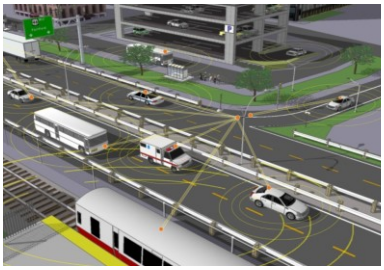
Focus Only on V-2-V Communications to Save Lives



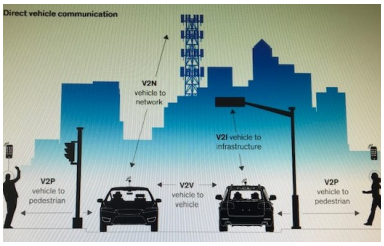
Source:
https://rosap.ntl.bts.gov/view/dot/27999

Forget roadside units and national access points. They are a huge waste of time and tax payers' money. Any report that claims otherwise is written to justify a pre-determined conclusion. If the European Commission and NHTSA really and truly want to reduce vehicle-related deaths and injuries, they will legislate the fitting of alcohol locks on all cars, trucks and buses; require identification of the driver to prevent vehicles from starting if the driver is not licensed; require the placement of governors on accelerators to prevent vehicles from exceeding the speed limits; and they will require cars to send the basic safety message to other vehicles – but NOT restrict how this should be done.

"The automotive industry has not resisted sending and receiving V2V messages per se. What they have resisted is NHTSA's and the EUROPEAN COMMISSION's attempts to tell them how to do it, and the governments' attempts to go beyond simple V2V."

DURING THE *2023 ITU/UNECE FUTURE NETWORKED CAR SYMPOSIUM* in March, the topic of remotely communicating with the on-board systems in a driverless vehicle came up in each of the four sessions. In the first session, Barnaby Simkin of NVIDIA described a proposed type approval process which would add remote monitoring of the on-board artificial intelligence systems while the car is in motion to ensure explainability to both users and authorities. In the session on automotive artificial intelligence which I monitored, Jenny Lundahl of RISE SWEDEN presented research on delivering risk prediction messages created with the help of AI from off-board systems to systems on-board vehicles. These messages would inform either human or robot drivers of a potential problem (e.g., the likelihood of ice on a bridge). Junichi Hirose of HIDO described work being done within ISO/TC 204 WG19, Mobility Integration, which is attempting to standardize back-office messaging for delivering automated driving services for low-speed automated driving. A good deal of Session Three on general automation was devoted to remote driving versus remote information assistance to driv-

erless software, and Session Four was totally dedicated to Vehicle-to-Everything (V2X)[1] communications.



Source: https://rosap.ntl.bts.gov/view/dot/27999ource: McKinsey

It appears that we take for granted that the more communication we have with the vehicle, both to and from it, the better. We accept as an article of faith that if only cars could talk to each other and with the infrastructure, many thousands of lives could be saved. In his keynote presentation in Session Four of *FNC 2023*, Michael Graham, board member of the *NATIONAL TRANSPORTATION SAFETY BOARD* (*NTSB*), stated that approximately 81% of all accidents that are not attributable to impaired drivers could be eliminated or mitigated by V2X. This figure supposedly comes from a 2014 study performed by the *U.S. NATIONAL HIGHWAY TRANSPORTATION SAFETY ADMINISTRATION* (*NHTSA*).[2] I searched through this report, but did not find any reference to 81% of accidents avoided. What I did find was the conclusion reached by the researchers that two applications of Vehicle-to-Vehicle (V2V), *Intersection Movement Assistance (IMA)* and *Left Turn Assist (LTA)*, could potentially save between 49 and 1,083 lives per year. The 81% has most probably been projected from all of the other safety applications that V2X would support.

Let's take the 81% figure and see what that means in terms of its potential and hoped-for impact. In 2020, of the 38,847 total number of people killed in motor vehicle crashes in the United States, 11,655 people were killed in crashes involving alcohol-impaired drivers, accounting for 30% of all traffic-related deaths.[3] That means that 27,192 deaths are not due to impaired driver (38,847 total deaths minus 11,655 impaired driver-related deaths). So 81% of 27,192 is 22,025 lives potentially saved or the severity of the accident mitigated. That's a lot of lives. (By comparison, there were 19,800 road deaths in EU countries in 2021, 13,200 of which were not impaired driver-related, half the number in the U.S.) Board Member Graham said that *NTSB* has been calling (actually pleading)

[1] V2X communications encompass vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-pedestrian (V2P) communications, collectively known as V2X.

[2] NHTSA. Vehicle-to-Vehicle Communications:Readiness of V2V Technology for Application (2014)
https://rosap.ntl.bts.gov/view/dot/27999

[3] NHTSA. Traffic Safety Facts 2020 Data: Alcohol-Impaired Driving (Report No DOT HS 813 294). Drug-related causes were not measurable.

for *NHTSA* to mandate V2X since 1995. In Europe, calls for V2X preceded the PROMETHEUS Project that was launched in 1986,[4] and the *EUROPEAN COMMISSION* has been attempting to mandate a V2X that would make it mandatory in all new vehicles, and, at the same time make it also mandatory for country governments to control the flow of messaging to and from vehicles through the C-ITS Deployment Platform.

The European Commission decided early in 2014 to take a more prominent role in the deployment of connected driving by setting up a C-ITS Deployment Platform. The Platform is conceived as a cooperative framework including national authorities, C-ITS stakeholders and the Commission, in view to develop a shared vision on the interoperable deployment of C-ITS in the EU. Hence, it is expected to provide policy recommendations for the development of a roadmap and a deployment strategy for C-ITS in the EU and identify potential solutions to some critical cross-cutting issues.

Why did the European Commission decide to take this upon itself? You can read my view on it in the May issue of *THE DISPATCHER* in *Musing of a Dispatcher: The Leviathan Syndrome*.

If we believe the safety claims, why no action?

We don't have V2V or V2X now in either the U.S. or EU, and it doesn't look like it is on the near horizon. Is that because we don't believe the safety claims, that almost two-thirds of all deaths and severe injuries could potentially be avoided? There are quite a few steps between sending a message and saving a life that would have to work perfectly if this could be realized. Wouldn't it be more effective to make sure that there are no possibilities for an impaired driver to get behind the wheel of a car? Alcohol locks work, don't require any communications, and would prevent almost a one-third of road deaths. Government regulators are starting to take action there, but progress has been slow.[5] Or is the lack of action because all the parties involved cannot agree on which technology should be used? That is certainly one reason. In

[4] The "Programme for a European traffic of highest efficiency and unprecedented safety"

[5] The EU has established a standard for installing aftermarket alcohol locks, but there is still no requirement for mandatory fitting of alcohol locks on all type approved vehicles.

the 2014 *NHTSA* report, *NHTSA* identified eleven issues that were raised by the automotive industry and other key stakeholders as concerns that should be addressed before putting V2X into law. Most of them were concerned with the actual technology to be used, which at the time was assumed to be DSRC devices.[6]

It's not the technology that's holding things up

Three of NHTSA's concerns went beyond the on-board technology: driver-vehicle interface performance; V2V privacy issues; and the security system to ensure a trusted and safe V2V system. These three topics are more important than how communications occur, and they grow significantly in importance when considering remotely communicating with the on-board systems in a driverless vehicle. Whether the automotive or telecommunications representatives, or the politicians and regulators who are engaged in discussions about V2X want to admit it or not, these issues, and not the technology, are the principal roadblocks.

No one seems to want to admit that once the vehicle-to-vehicle communications can is opened, like any can of worms, there is really no telling what is going to happen. We are not sure where to stop once we get started, and, more importantly, who will be responsible for what. The tests that have been performed for the past twenty or more years have been based on vehicles delivering the Basic Safety Message to other vehicles.[7]. This has been standardized by SAE. However, as soon as vehicle communications is mentioned, dozens of use cases are placed on the table as 'must-haves' if V2X is truly going to make a difference. That's a problem, and I want to thank one of the panelists in Session Four of the FNC 2023 SYMPOSIUM for igniting the spark for that idea. It was Ted Bailey, Cooperative Automated Transportation Program Manager for the WASHINGTON STATE DOT. "*The state doesn't want to have an infrastructure to do things that will*

[6] DSRC – Dedicated Short Range Communications Service - a technology for direct wireless exchange of vehicle-to-everything and other intelligent transportation systems data between vehicles, other road users, and roadside infrastructure. DSRC, which can be used for both one- and two-way data exchanges, uses channels in the licensed 5.9 GHz band. DSRC is based on IEEE 802.11p.

[7] SAE J23735 https://www.sae.org/standards/content/j2735_202007/

affect safety-critical applications," he said. *"The liability is too high. From our standpoint, V2V is really better. Start there."*

How many wars were started by missionaries?[8]

There are two problems that I see with the public debate about communicating with vehicles. First, those who have taken up the cause—or the crusade—on the government side have neither acknowledged nor understood what the automotive industry has been doing for decades with their research, development and implementation of communications systems and services for their vehicles. It's like religious missionaries showing up in a jungle or on a remote island and lecturing the people they meet on how to change the way they live their lives. (The religious fervor of the Commission has its roots in this tradition.) Second, involving the public sector in communications with vehicles, either receiving messages from or sending messages to them, is so fraught with unforeseen consequences that it may be too dangerous to even consider allowing them in.

I realize I risk being burned at the stake for heresy, but I am confident there are plenty of others who have the same opinion, and they will form a human shield to protect me from the *EUROPEAN COMMISSION*'s *Inquisitori*.

Take off the ear muffs and listen

I believe government transport bodies and organizations like the *EUROPEAN COMMISSION* have been trying to do too much, ignoring the work the automotive companies have been doing on delivering and receiving messages within a vehicle manufacturer's walled garden—and every OEM has its own walled garden, some for over twenty-five years. The automotive industry has not resisted sending and receiving V2V messages per se. What they have resisted is the *EUROPEAN COMMISSION*'s—as well as *NHTSA*'s up to 2020[9]—attempts to tell them how to do it, and the governments' attempts to go beyond simple V2V. It is the complexity that

[8] They send in the missionaries to convert the natives, and then when the missionaries are threatened, they send in the troops to protect them. That's the way the world worked until after World War II, and it is still how it works in some places.

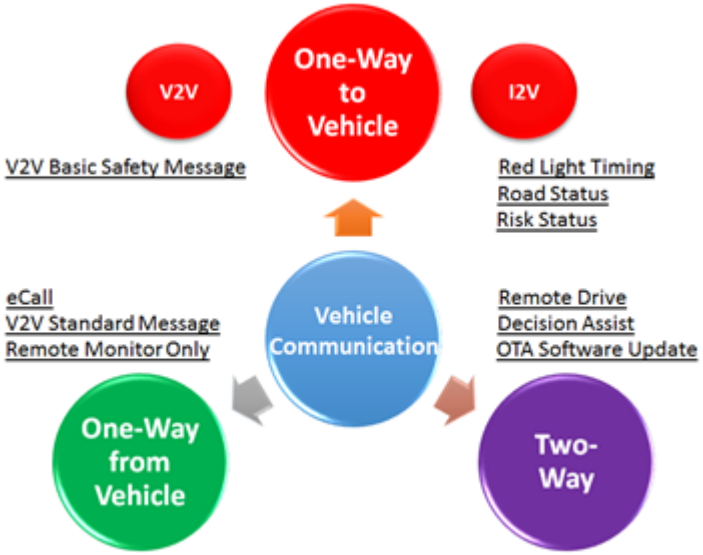
[9] In 2020, the U.S. Federal Communications Commission voted to shift 30 MHz of the 75 MHz that had been reserved for DSRC to Cellular-V2X, and moved the remaining 45 MHz to Wi-Fi use.

has been preventing simple V2V messages from gaining traction among the automotive OEMs and preventing a workable solution from being implemented. V2V messages could make a major difference in improving safety, such as with *Intersection Movement Assistance (IMA)* and *Left Turn Assist (LTA)*, but anything more than this raises too many difficult issues.

I have made a lot of claims here. Let's start with the basics so that I can explain why I have made them. There are three types of external[10] communications involving vehicles:

- One-way to a vehicle
- One-way from a vehicle
- Two-way to and from a vehicle

One-way to a vehicle



The simple shout-out "I'm here!" delivers information to any vehicle in the vicinity of the sending vehicle—whether there is a human or a robot driving either vehicle—that a vehicle is approaching at a certain speed and is or isn't braking. The data is processed by the receiving vehicle and presented to the human or robot, who assesses the situation and takes action based on that assessment. The burden of doing something with a sent message is on the receiver of the message, not on the sender.

Neither a human nor a robot knows for certain whether the message sender is going to run a red light, ignore a stop or yield sign, turn or go straight (even if the message includes the turn signal status). Even if the message sender is speeding, the on-board software cannot be absolutely certain that the driver won't slam on the brakes at the last moment, but if that software is doing its job, it should deliver a warning

[10] There are plenty of communications going on inside the vehicle between the electronic control units over the CAN (Controller Area Network), LIN (Local Interconnect Network), Flexray, and via Ethernet.

to the human or the robot and perhaps even slow the receiving vehicle down before either the human or the robot decides what he/it wants to do.

Remote door unlock, remote climate control, and remote start of stolen vehicle tracking are simple messages have been part of the repertoire of telematics systems since their start almost thirty years ago. These are also one-way messages to the vehicle, in this case sent from a command and control center. Another type of one-way to vehicle message is from the infrastructure, and could include red light timing, warning messages about road surface conditions, roadworks or traffic incidents. There is a relatively long history of warning messaging extending back to RDS-TMC.[11] Proprietary traffic messaging has been used by TOMTOM, WAZE and car companies like VOLVO that send road surface warning messages via their telematics infrastructure.

One-way from a vehicle

Vehicles have been sending data messages using wireless communications for more than thirty years. Simple messages like "Load Delivered" or "Leaving Loading Dock" were among the first. VOLVO TRUCKS introduced its *Dynaguide* messaging system around 1994. (See sidebar image of *VOLVO TRUCK*'s *Dynaguide*.) Emergency call messages, like GM's *OnStar* and Volvo's *Volvo On Call* delivered an SOS message to a call center and opened up a phone line for a voice call. *OnStar* was commercialized in 1996 and *Volvo On Call* in 2001. The V2V Standard Message is also one-way from the vehicle, just as it is one-way to a vehicle. There is no notice sent from the receiving vehicles to the sending vehicles that a message has been received in the SAE J23735 V2V Basic Safety Message, but there are confirmations sent from the vehicles to the sending sources that have been developed by the OEMs.

The Volvo Trucks Dynaguide System circa 1994 – Early Messaging System

Some companies are remotely monitoring their vehicles without any messages being sent back to the vehicles other than perhaps message receipt confirmation. In 2011, GM made their *OnStar* Terms of Service explicit on the issue of data collection. The new TOC stated that "OnStar has the

[11] RDS-TMC - Radio Data System (RDS) is a communications protocol standard for embedding small amounts of digital information in conventional FM radio broadcasts.

right to record your location, speed, safety belt usage, whether the car is running or not, and other factors as it sees fit -- and it can share that data with 'any third party, provided the information is anonymized'". TESLA is constantly monitoring the cars it sells. We know this because anytime one of its cars is involved in incident, the company is quick to tell us that either the driver of the TESLA or something outside the TESLA was responsible—and not the car or the management or the staff that programmed the software.

Two-way

Car OEMs have been doing two-way communications with their vehicles for as long as they have been putting wireless modems in them, which began around 1994. Some services are initiated from the vehicle and others triggered from outside, so two-way communications had to be standard once the OEMs got beyond the basic "I'm here" type messages. Over-the-air (OTA) updating is a very demanding type of messaging because it often involves very large datasets, and it requires constant two-way communication between the sending server and the vehicle's systems. The vehicle's electrical system needs to be on when the OTA process is running, which is why TESLA was first to deliver it on a production scale.[12] When a TESLA was being charged overnight, there was usually enough time for a software package to be delivered and loaded into cache, and then a full replacement of the previous software version could be completed. This is not an easy feat with ICE vehicles that are turned on and off quite frequently and then are completely off when they are parked.

When less really is more

Vehicle OEMs, their communications equipment suppliers, and the telecommunications network companies have been working together to deliver data messaging to and from vehicles for almost three decades. It is complicated, not the least because mobile networks started out as incompatible, regional/national solutions with AMPS and CDMA in the U.S., GSM in Europe and PDC in Japan. They have gradually been standardized as they have moved from the first and second generations to 5G, with 6G in the advanced planning

[12] Tesla introduced OTA in 2012 when it began selling the Model S.

stages. Advancements have moved forward thanks to the international bodies, like the INTERNATIONAL TELECOMMUNICATION UNION, a United Nations organization, and the various nonprofit standards groups, such as ANSI and ETSI.[13]

When the EUROPEAN COMMISSION has attempted to steer telecommunications developments, as it has done with vehicle-to-everything communications and as it did with European eCall, the results are spotty at best, with excruciatingly long development timeframes. They start out with the solution, without either fully understanding the problem or either the potentials or limitations of the technology. Example One: The *COMMISSION* declared that emergency messages from the vehicles had to go directly to the public service answering points (PSAPs), and the phone call had to be free. Therefore, it declared, it had to be a 112 call. Example Two: Vehicle communications cannot depend on having a subscription service (SIM-cars), so it has to be DSRC.

When you read what the *COMMISSION* is proposing in the final C-ITS Platform Phase II report that was completed in September 2017, it is understandable why nothing has happened since then—even if one considers the effects of the COVID-19 pandemic on everything.[14] It is totally clear on what the *COMMISSION'S* intentions are, and this clarity has most probably frightened both country road authorities as well as putting the fear of death in the automotive industry and its suppliers. Here is what it states:

Page 54 – *"It was understood by Working Group members that the business models of C-ITS deployment would influence which stakeholder would be responsible for the installation of the relevant on-board units across the different vehicles. For example the public transport operator may take the responsibility as part of a business decision and also due to the fact they are in the position to request certain equipment during a tender and service level agreements etc. but it could also be local authority directly as part of a local strategy. Moreover, it could even be part of a legal agreement."*

[13] AMPS-Advanced Mobile Phone System; CDMA-Code Division Multiple Access; GSM-Global System for Mobile Communications; PDC-Personal Digital Cellular

[14] https://transport.ec.europa.eu/system/files/2017-09/2017-09-c-its-platform-final-report.pdf

You might notice that the automobile manufacturer into whose vehicles the 'on-board' unit would be placed is not mentioned.

Page 55 – *"Who will operate the relevant C-ITS services is an important consideration that deserves more attention. Generally speaking, both private service providers and the local authorities can operate the C-ITS services, however depending on the type of service and the associated business model, it may be more appropriate for the local authority to operate, if feasible."* Again, there is no mention of the automobile companies that are already contracting with private organizations to obtain relevant traffic and transport information, and have been delivering useful information to drivers for over two decades.

Page 55 – *"The operation and management of cooperative-intelligent transport systems requires a substantial set of data and 'digital infrastructure' as defined in the physical and digital infrastructure. These data, including data related to electronic distribution of local traffic regulation, require data collection, data management and data distribution. This is a new functionality, that may be implemented in different ways, but is a new core service provision, without which C-ITS will not function effectively in the urban environment."* There is already in place an infrastructure for collecting and distributing data in a secure manner, and it is operated by private service providers and the automotive industry.

Are government bodies really prepared to take the liability?

If a public body is going to assume the responsibility of procuring and demanding the installation of a particular piece of hardware and associated software in a vehicle, it is going to have to take on the same legal responsibility that is accepted by the automotive manufacturers and their suppliers. It can try to encircle itself with regulations that attempt to shield it and hold it harmless, but these will most like not be upheld in the highest courts.

If a public body is responsible for delivering messages—and this is what is being proposed by the *EUROPEAN COMMISSION* with its National Access Points[15]—it has to be certain that the data used to prepare the messages is verifiably accurate.

15 https://transport.ec.europa.eu/transport-themes/intelligent-transport-systems/road/action-plan-and-directive/national-access-points_en

This is what Ted Bailey from WASHINGTON STATE DOT was warning about, and why he said that governments should not be in the message-relaying business using data that is coming from outside its own data sources. In the legal section of the C-ITS Platform document there are only references to issues of privacy. There is not a single mention of taking legal responsibility for the correctness or timeliness of data delivery.

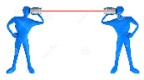
What happens when a local authority takes on the task of sending risk prediction messages to vehicles, and its software misses a stretch of road where there is black ice? Who bears the responsibility if a car, with a human driver or driverless, skids off the road, kills a pedestrian and a passenger in the vehicle is paralyzed for life. What happens when a message from a roadside unit tells a vehicle that a traffic signal will turn green in x seconds, but when the car reaches the signal in x seconds it is still red? The car's sensors see red, and tell the car to stop, while the messaging processing unit tells the car to pass on through. A human will stop. A robot will get confused.

Get out of the way and let them get on with it

The vehicle communications deadlock is the result of having people in charge of too-powerful organizations who have no fundamental knowledge of transportation or communications systems. They are political appointees who have fixated themselves on a topic which they believe fits within their political ideology or will help them to move on to their next career stepping stone. They surround themselves with staff who do what they are told so that they can move with their boss to the next step. They lock onto a single idea and can't let it go, even when knowledge, logic and common sense shows it is a bad idea.

Isn't there someone reading these words who has a modicum of influence in the halls of government who can convince someone who can call off the guard dogs preventing knowledge, logic and common sense from entering into the room where decisions are being made? Tell the person who can call off the guard dogs to tell the automotive industry: **Make one-wayV2V work**. Get *Intersection Movement Assistance (IMA)* and *Left Turn Assist (LTA)* into all new vehicles within, let's say, three years, and see if you can find a solid

aftermarket solution while you're at it. The specification is done; the protocol is finished. Leave the technology issue totally up to the industry. Just say that it has to work, and that it has to continue to work as new generations of communications system are introduced.



Dispatch Central

There's ~~gold~~/rhodium in them there hills

MORE CAN BE done to stop the thieves from ripping our cars apart to get at the precious metals and expensive gadgets that are being put into them. Cars have become gold mines for the prospecting thieves and the unscrupulous scrap dealers. It was one thing when they broke a window to make off with a radio, like they did twice with the removable radio in my 1983 (and I finally gave up on replacing it), or a navigation system, but now they are disemboweling our cars to get at the platinum (Pt), palladium (Pd), and rhodium (Rh).

A catalytic converter is part of a vehicle's exhaust system and functions as an emissions control device. It converts toxic gases and pollutants in the exhaust gas of ICE vehicles into less toxic pollutants, accomplishing this by adding a substance (catalyst) that increases the rate of a chemical reaction. Their use began in 1975 to comply with the U.S. Environmental Protection Agency's stricter emissions regulations. The catalyst is a mix of the precious metals listed above. Cerium, iron, manganese, nickel and copper are also used. Nickel is not legal in the EU because of its reaction with carbon monoxide into toxic nickel tetracarbonyl.

The precious metals are not cheap. Platinum is around $800 per ounce, palladium $900, and rhodium was up around $30,000 per ounce in 2021, but has now settled in around $20,000. The average catalytic

converter contains about 1-2 grams (0.0353 – 0.0705 ounces) of rhodium. It also has about 3-7 grams of platinum and 2-7 grams of palladium.[16] That means that the precious materials in a single catalytic converter are worth approximately $1,255. That's an indication of why a catalytic converters for some car brands cost between $2,500 and $4,500. There are cheaper ones made by GM and Ford, which apparently still meet the EPA specifications, and these contain lower amounts of the precious metals.

Clean air at any price

The EPA Act dictated that all vehicles built from 1975 had to include a "two-way" catalytic converter to pass the emissions test. This meant that it removed both carbon monoxide and unburned hydrocarbons from the exhaust fumes. In 1981, "three-way" converters were required that would also eliminate nitrous oxide emissions.

I have looked for information about the original development of catalytic converters to see if anyone thought about the cost of the materials that were being added to the vehicle. I found an article from September 11, 1974 in the *TOLEDO* (Ohio) *BLADE*.[17] It was written by General Motors as an infomercial: *General Motors believes it has an answer to the automotive air pollution problem*. Here's how it answered its own question: Why is GM using platinum and similar metals in its converter? "There are two basic demands made upon a catalyst: it must be efficient and it must be durable. GM scientists have determined that small quantities of platinum and palladium coated on pellets of aluminum oxide meet these requirements." There was no mention of price. It will cost what it cost, and consumers can thank their government for the amount it would add to the MRP.

What goes around comes around

Catalytic converter theft in the U.S. has followed the curve of Rhodium prices, and has risen from 1,298 reported thefts in 2018 to 52,206 in 2021, according to claims data from the NATIONAL INSURANCE CRIME BUREAU. Nationally, 37% of catalytic converter theft claims tracked by the bureau in 2021

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16 https://www.repairsmith.com/blog/how-much-rhodium-is-in-a-catalytic-converter/

17 https://news.google.com/newspapers?id=9tBOAAAAIBAJ&dq=catalytic-converter&pg=6404%2C6576523

were in California. This is a disproportionate share of the total, considering that California is just under 12% of the total population. Older Priuses, are most often targeted, according to claims data provided by the AAA Automobile Club of Southern California. Hybrids have two converters and the parts tend to get less wear, making them more valuable, according to the National Insurance Crime Bureau. There is a good case that can be made for California being responsible for catalytic converters in the first place, and it is home to the most *Priuses* and *Teslas*.

Slash and dash in a flash

They can remove a converter in minutes using a quiet-as-a-mouse powerful electric saw. They don't set off alarms—unless they are the Tesla-type video motion type. The thieves are rarely caught in the act. If thief is found with a stash of them, they can always claim they came from a junkyard or they were gifted them by an uncle who owns a repair garage. Because they are unmarked, they cannot be traced to a particular car. There is a bill before Congress with bipartisan support called the *Preventing Auto Recycling Theft (PART) Act*, which would require identification numbers to be etched on converters, and make their theft a federal offence.

Anything that's worth something will be stolen

Catalytic converters are only one of many goodies that car companies load into their cars without thinking about what the ramifications will be if they are stolen. Or maybe Saab had figured how much it would earn every time I returned to them to replace the radio that had been stolen, or maybe GM figures how much profit every gram of Rhodium in their CCs adds to its bottom line. For car owners, it's a damn nuisance, whether it's the entire car that is knocked off or a navigation system that is boosted. It's worse when not replacing the stolen part is not an option, and that is the case with catalytic converters. You cannot drive around without one.

They never should have been put into the cars in the first place until there was a solution that did not use expensive "precious" materials. The same goes for batteries and the materials going into them. Stuff is precious because it's rare, and if it's rare, it shouldn't be used in gadgets that can wind up in a junk yard.

Ford's Farley finding electrification daunting

WHAT WOULD YOU do if you owned a hamburger joint and every regular burger you sold for $2.50 earned you a $0.25 profit, and every vegan burger you sold for $3.50 cost you $7.00 to make? That's sort of the predicament FORD finds itself in right now, except the vegan burgers are battery electric vehicles. In March it announced that it had lost $2.1 billion on its electric model business in 2022. That was twice as much as it had lost in 2021 on EVs. After losing $733 on its EV business in the first three months of 2023, it's on pace to lose $2.9 for the entire year. This piece of news came to me by way of *Morning Volt*, a daily news feed called *REALCLEARENERGY* that is a sub-site under *REALCLEARPOLITICS*, which seems to lean to the right. The article on FORD was on a blog called *NEWGEOGRAPHY* by Robert Bryce.[18] I've doubled-checked the figures, and they appear to be kosher.

FORD delivered a modest number of electric vehicles in 2022, 61,575 to be exact. That was 69% of all the electric vehicles the company has produced since it started its electrification drive in 2020. Just for comparison's sake, TESLA delivered almost twice as many of its BEVs per month in 2022 as FORD delivered in an entire year.

The company made a profit of $10 billion in 2021 on revenue of $136 billion when it delivered a total of 1.94 million vehicles in the U.S. and 3.1 million vehicles in total, most of them what I call 'normal' cars.[19] In 2022, it had revenue of $158 billion and a net loss of $2.1 billion on U.S. sales of 1.82 vehicles. Through April, sales are up around 10% in the U.S., and although management said in 2021 that it would sell 600,000 electric cars by 2023, that looks delusional right now. Those bright predictions in '21 caused FORD's stock to rise over 46% at the beginning of '22, but the bottom fell out of its stock price in '22 as the losses mounted and the number of EVs never could quite meet expectations.

"We should have done much better last year," said Farley in February, commenting on the company's performance in a press

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18 https://www.newgeography.com/content/007816-ford-losing-66446-on-every-ev-it-sells

19 China was 0.6 million; UK 0.2 million; Germany 0.2 million; Canada 0.2 million; U.S. 1.9 million

release. *"We left about $2 billion in profits on the table that were within our control, and we're going to correct that with improved execution and performance."*

I think it would be fairer to say that FORD left $2 billion at the table, not on the table, and the table is a high stakes game of *no limit Tesla hold 'em*. It's not going to get any easier, Jim, with Musk playing chicken with car pricing and the Chinese models just waiting on ships in the Pacific ready to roll off and into the waiting arms of cash-strapped American car buyers.

A new China strategy is also in the works

In 2006, FORD sold 1.3 million units in China compared with 600,000 in 2021. In 2022 it had only 2.1% market share in the biggest car market, and its sales continued to fall in 2023. It lost $572 million on its Chinese operations. In May, Farley announced that it was lowering its investments in China and concentrating on commercial and electric vehicles. It's swimming against the current. China's consumers follow the lead of their government, and their government is going to punish U.S. companies as long as there is a trade war between the two countries. The U.S. electric vehicle laws are aimed directly at Chinese car companies, and the Chinese government is not going to do any favors for FORD, GM, or TESLA.

What's a burger flipper to do

The obvious advice to the owner of the burger joint is to stop making vegan burgers and stick to the real deal where you can make a profit, pay your bills, and build up the business so you can sell it and retire to The Villages in Florida. FORD doesn't have the option of forgetting BEVs because every country where it sells its cars is making it impossible to sell what FORD (and GM and every other car company except TESLA) can profitably build: ICE

Sooner or later the Ford family is going to throw in the towel and sell out to BYD, GEELY or someone else that wants to continue to produce ICE vehicles and sell them in Africa, South America, the Middle East, India and most of the rest of Asia. Once the buyer takes all the safety- and emissions-related costs out of the vehicles that the EU and the U.S. forced them to put in, the buyers will have great cars at an affordable price, and there'll be one less American car company to worry about.

Volvo Cars exceeds market expectations…

…THEN LAYS OFF 1,333 employees. The unions cried "Foul!" A week before the layoff notice, on the 28th of May, the words that were used by the business press to describe what VOLVO CARS had done to the market estimates for its profitability was ***"They crushed it***!". Its net profit for the first quarter of 2023 was $510 million, while the market was expecting something around $350 million. Revenue of $9.5 billion for the quarter also exceeded expectations. Adding to the positive news was the company's declaration that it had closed its order book for the first deliveries of the EX90, its fully electrified version of the flagship SUV, XC90. First deliveries of that model were scheduled for the end of 2023.

Asked by a market analyst how consumers who are supposedly having difficulties keeping the fridge full due to rising prices and an unsettling economic outlook can afford the $100,000+ price tag for an EX90, the company's head of finance, Johan Ekdahl, responded: "That's a good question." He admitted that it's not in VOLVO's home market of Sweden where the car's buyers are located. There, the car sales market in general, and BEV sales in particular, have nose-dived as a result of the Swedish government halting handouts to BEV buyers.

Don't compare us to Tesla

The same day as the good financial news, VOLVO CARS' CEO for the past year, Jim Rowan, gave an interview to a reporter from Sweden's largest daily newspaper who seemed determined to get under Rowan's skin with his questions.[20] Rowan said that the big challenge isn't electrification, it's software development. Unlike TESLA, VOLVO is not thinking of playing the razor blade game, dumping the price of its cars and making money by selling software functionality. *"We will make money by selling cars with fantastic content,"* declared Rowan to an obviously skeptical journalist.

The journalist reminded Rowan that VOLVO's stock had fallen by 17.7% since the start of the year on the Stockholm stock exchange which had risen by 7.4% during the same period. He reminded Rowan that a few years ago, TESLA sold half as many cars as VOLVO, and this year will sell at least

[20] *DAGENS NYHETER. 28 APRIL 2023. Teslas not ahead of us with technology.*

twice as many—perhaps more. Then he asked Rowan if he was satisfied with the company's stock price. Rowan answered that he believed the company was making the right decisions for the long term, that he believed the company was hiring the right people, and that he was happy with the changes the company was making to meet the electric future.

A week can seem like an eternity

One week later, to the day, another type of news was reported by VOLVO, this time by the one of the company's press spokesperson. Six percent of the company's Swedish workforce will become, what they call in Rowan's home country, 'redundant'. *"We have to be both cost-effective and resource-effective, but we also see a rather large increase in competition in our segment,"* said the spokesperson. *"As a result of our costs increasing significantly recently, we felt we needed do something to ensure our future profitability and have a more 'sustainable' cost base."* The company said there would be further cost reductions in the near future by cutting down on the number of consultants (i.e., the hired help who operate as employees of VOLVO, but who are actually paid by job shops) and other external services providers.

The union which represents most of the non-manufacturing employees at VOLVO said in a statement that VOLVO should have done a better job of planning its finances if it can report a profit one week and layoffs the next. Little has been done to retrain workers to prepare them for different roles in an all-electric car company, said a spokesperson for the union.

There's an old saying about how a company should deliver bad news: Do it all at once and get it over with. VOLVO's current management doesn't seem to have gotten that particular memo. One more week passed and a bigger bomb dropped.

"*Demand for the Volvo EX90 remains high and to ensure a high-quality introduction of the car and to maximize customer benefit from its technology from day 1, Volvo Cars needs additional time in software development and testing and is adjusting the planned start of production timing,*" said a company statement. "*Production is now expected to begin in the first half of 2024.*"

It isn't just VOLVO's EC90 that will be affected by the software development delay. POLESTAR, which is 49.5% owned by VOLVO CARS and around 45% owned by GEELY, was also planning to introduce a new model, the *Polestar 3*, at the end of 2023. It shares the same software platform with VOLVO. POLESTAR announced that it will start production during the first quarter of 2024. Its share price, which had already been battered for other reasons, was trading at $0.70 per share, 15% of its all-time high in November 2022.

Eleven-or-so years ago, a few years after it had been acquired by GEELY, VOLVO had some software problems. Stefan Jacoby, who had come from Germany and VW, had been appointed CEO after GEELY took over. He hadn't even gotten his seat warm, but the new owners felt there needed to be a change. That's when Li Shufu brought back a Swede to the top job, Håkan Samuelsson, and he brought people in to replace all of Jacoby's top hires, including those who were in charge of the software development team. There is one main rule in the automotive business. Don't miss a start of production date. Both VOLVO CARS and POLESTAR are missing their SOPs. We won't be surprised if heads roll.

Zoox takes self-certification into uncharted waters

IF I SAY I'm okay, I'm okay. That's basically how ZOOX has interpreted its compliance with NHTSA's *Federal Motor Vehicle Safety Standards (FMVSSs)*. Never mind that the *Standards* are based on vehicles that have controls for humans to steer, accelerate, and brake. NHTSA has granted itself the right to waive these requirements if a company applies for such a waiver, but ZOOX has decided it doesn't need to do so. It says it meets all the crash tests, so that should be enough.

What has NHTSA done? Pretty much what it has done with the other juvenile delinquent who thumbs his nose at all authority and who keeps telling them that his Full Self-Driving is not self-driving while he tells his customers plunking down $15,000 for it that it is. NHTSA has been "scrutinizing" ZOOX's claims that it meets FMVSS in spite of the fact that it clearly DOES NOT. Why not? Because it has ignored those parts of FMVSS which refer to manual controls. Let's start from the beginning. What is FMVSS?

FEDERAL
MOTOR VEHICLE
SAFETY STANDARDS
AND REGULATIONS

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC
SAFETY ADMINISTRATION

SAFETY ASSURANCE

OFFICE OF VEHICLE SAFETY COMPLIANCE[21]

The National Highway Traffic Safety Administration has a legislative mandate under Title 49 of the United States Code, Chapter 301, Motor Vehicle Safety, to issue Federal Motor Vehicle Safety Standards (FMVSS) and Regulations to which manufacturers of motor vehicle and equipment items must conform and certify compliance. FMVSS 209 was the first standard to become effective on March 1, 1967. A number of FMVSS became effective for vehicles manufactured on and after January 1, 1968. Subsequently, other FMVSS have been issued. New standards and amendments to existing standards are published in the Federal Register.

These Federal safety standards are regulations written in terms of minimum safety performance requirements for motor vehicles or items of motor vehicle equipment. These requirements are specified in such a manner "that the public is protected against unreasonable risk of crashes occurring as a result of the design, construction, or performance of motor vehicles and is also protected against unreasonable risk of death or injury in the event crashes do occur."

Standard No. 101 - Controls and Displays - Passenger Cars (Effective 1-1-68) This standard requires that essential controls be located within reach of the driver when the driver is restrained by a lap belt and upper torso restraint, and that certain controls mounted on the instrument panel be identified.

Part 555 - Temporary Exemptions from Motor Vehicle Safety Standards (Effective 1-29-73)
This regulation provides a means by which manufacturers of motor vehicles may obtain temporary exemptions from specific safety standards on the grounds of substantial economic hardship, facilitation of the development of new motor vehicle safety or low-emission engine features, or existence of an equivalent overall level of motor vehicle safety.

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[21] https://web.archive.org/web/20140507031818/http://www.nhtsa.gov/cars/rules/import/FMVSS/index.html#SN101

Why should I care about manual controls?

It seems that Zoox has decided that since its car doesn't have manual controls, the manual control requirements don't apply to it. Would the FEDERAL AVIATION ADMINISTRATION allow an airline to start flying planes with no cockpit if an airline decided that it could save money by eliminating it? *"We fly on auto pilot, so those requirements about pilot controls don't apply to us."* How do you think that would go down? And planes have proven that they can actually fly with auto pilot? What has Zoox proven? Zilch.

Zoox, like GM Cruise and any other company that wants to put vehicles on the road without any human driver controls should apply for a dispensation from *FMVSS*, and then seek a permit from the state and local authorities to operate on their roads. That way, everyone—including the people riding on the vehicles—is clear about the ground rules. The vehicle is being tested. It does not fulfill all the legal rules of the road, but it has been granted a temporary pass to operate to determine if the rules should be changed in the future. I think the world has had enough of the *"I won't ask for permission or forgiveness"* rubbish. There are reasons for rules and regulations: follow them. Period.

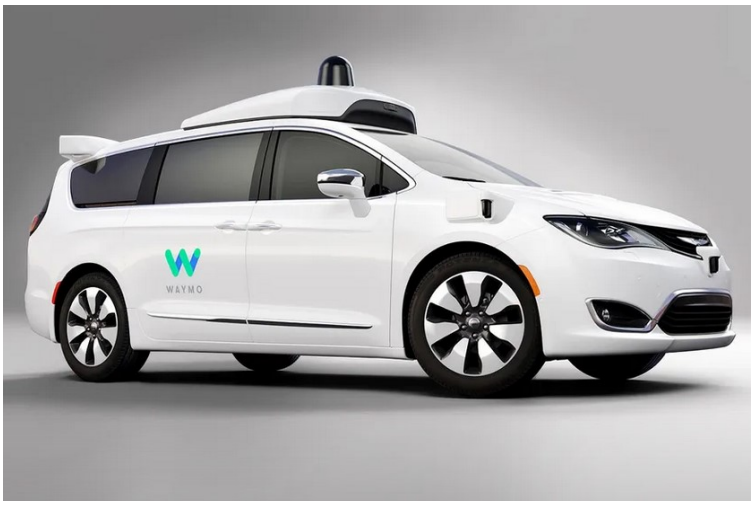
Do you know the way to San Jose?

For Zoox, it doesn't matter if it's in one direction or the other.

Quick Transactions

Waymo cutting the cord with Chrysler Pacifica

THE CAR THAT brought it to the dance. That is what best describes the Chysler Pacifica. It was in 2016, two years after FIAT and CHRYSLER had merged into FIAT CHRYSLER AUTOMOBILES (FCA), that FCA and Waymo showed off the first *Chrysler Pacifica* hybrid electric minivans equipped with Waymo's self-driving/driverless technology. There were 100 of them fitted out with Waymo's kit, as seen in the one to the right. John Krafcik was heading up Waymo then, and he assured everyone that Waymo would not be making and manufacturing its own vehicles, but integrating its technology into vehicles made by automakers.



In January 2018, Waymo said it would start running a "truly driverless" service in Phoenix, and would be purchasing "thousands" of *Pacificas*. This was nine months before a vehicle equipped with UBER self-driving software and hardware ran and killed into Elaine Herzberg in Phoenix, and everyone just decided to slow down. Waymo never bought thousands of *Pacificas*. It has a stable of around 700 vehicles in total, mostly Pacificas.

In March, Waymo announced that it would be retiring its *Pacifica* fleet, replacing them with *Jaguar I-Pace* battery electric vehicles. This move is part of Waymo's decision to become part of the U.S. government's *EV Acceleration Challenge*, a public/private investment initiativer for "Affordable Electric Vehicles". It is part of President Biden's goal of having 50% of all new vehicle sales being BEVs by 2030. There are likely to be tax incentives accruing to Waymo, although these are not mentioned in any of the announcements.

Moving to fully electric vehicles will add a new dimension to Waymo's service: charging. The *Jaguar I-Pace* has a 292 mile (467 km) range, which is plenty for a single day of operation at eight hours/day. The *I-Pace*s will be charged at

Waymo's depot, and topped up if needed wherever they can find a plug.

Waymo also announced recently that it has a new partnership in the making, with GEELY's *Zeekr* brand. The two companies announced their cooperation at the end of 2021, and now it appears that they are ready to start rolling them out. I'm not sure how cooperation with a Chinese brand fits with the rest of the U.S. policy on sourcing U.S.-made batteries and products, but I guess Waymo management has figured out how to put a good spin on that.

Les parisiens disent non aux trottinettes électriques

ELECTRIC SCOOTERS WILL become *machina non grata* on the 1st of September this year in Paris after a plebiscite in which only around 8% of eligible Paris voters took part. Almost 90% of those who voted decided to ban them. That was 103,000 of the total number of 1.38 million Paris residents who have the right to vote. Anne Hidalgo, the "fifteen-minute" Socialist mayor of the city, had come out against e-scooters, which is what led, in part, to the referendum, and, in spite of the low turnout, she says she is "committed to respecting the choice of voters, purely and simply".

There's a not-so-little catch here. The ban only affects e-scooters for-hire, not privately-owned ones. This has to do with why the ban was proposed in the first place. People finally got fed up with the blasted contraptions lying all over the place and being driven without any concern for those with whom they were supposed to be sharing the road.

In 2018, Paris became one of the first cities to welcome electric scooters. Hidalgo, a Socialist, had been mayor since 2004, and has supported all efforts to eliminate cars from the city and welcome bicycles. It seems she and her staff thought e-scooters fit neatly into the party's "two wheels good, four wheels bad" ideology. Then, as the reality of e-scooters began to become exposed—the one that has shown their true colors wherever they have been allowed—it appears the mayor began distancing herself from them. There was the way they were being driven, weaving around cars and pedestrians on streets and sidewalks, the speed at which they were driving, making them potential killers for anyone they hit. A scooter carrying two people hit and killed a 31-year-

old tourist from Italy. She hit her head when she fell to the pavement and died of cardiac arrest.

The mayor raised the minimum age for renting them to 18, limited the number that could be put onto the streets to 15,000, forced the rental companies to put governors on the scooters to limit their speed, made it illegal to have more than one person on them. As in other cities (Stockholm is one of them), restrictions are not followed because there is no one to enforce them. So the mayor called for the referendum, and how the result is in. Will it be followed or overturned by mass protests (the French are good at those sorts of things). We shall see.

One thing is clear: If the politicians who were in government when e-scooters showed up had been doing their jobs and had established all the ground rules BEFORE the scooters' wheels were allowed make their first rotations, the injuries and deaths the scooters have caused, and the disruptive clutter they have added to cities, would have been prevented.

Musings of a Dispatcher's Friend

The *Guest Musings* is written by Glenn Mercer. Glenn was at McKinsey in the Automotive practice for two decades, and for 15 years since then has been an independent automotive researcher active in the worlds of private equity, venture capital, academia, and industry associations. He can often be seen presenting work at National Auto Dealer Association (NADA) meetings across the USA. He currently lives in the American Midwest. He irregularly blogs at https://glennmercer.substack.com/.

Direct or Indirect Distribution of Cars

EVERYWHERE AROUND THE world there is an ongoing debate about whether direct-to-customer distribution of cars (DTC) or indirect distribution (IND: wholesalers, agents, dealers, etc.) is superior. I won't weigh in on my view of this here, but will point out that this debate almost always omits two key realities, regardless of where you come out on the DTC vs. IND question.

First, though not the main point of this note, the debate usually conflates "new car dealer" with "new car sales" (we are ignoring here used-car-only stores). Of course, without sales of new cars there would be no reason for either IND or DTC stores to exist. But, once there is a flow of new cars out of the factories, IND and DTC stores usually can and do take on other functions. These include:

- Service of cars (which is comprised of both parts and labor, and includes factory-paid recalls and warranty work, customer-paid maintenance and repair, and internally-paid reconditioning of used cars),
- Arranging of financing of cars (cash, lease, loan, "subscription"), and
- Used car operations (purchase (often as trade-ins), refurbishment, and then resale of used cars).

Additional functions can include collision repair (usually handled separately from regular service: note even Tesla does regular service in-house but often out-sources collision repair), car rental, the sale and installation of accessories, and more.

The point of running through this long list is that any debate which focuses on the new-car process only will provide an incomplete answer to the question "What is the best sales channel to use?"

In many cases, in fact, the channel (as distinct from the factory) will derive most of its profit not directly from new-car sales. Thus in 2018 (I am using a pre-Covid pre-chip-shortage year), the average U.S. dealer made 25% of its store-wide gross margin from

new sales, 25% from used sales, and 50% from service (NADA data). The situation is different at the factory, but even there the new car itself is not the whole story. One only has to look at the prices of, say, BMW repair parts to realize that the oft-cited assertion is true, that sales of such parts can generate half of an OEM's total profit.)

But let's move on to the second missing part of the debate: when we argue about new-car sales channels, the discussion almost always flows from customer-back rather than factory-forward. That is, most of the debate revolves around what the customer wants. And of course this is a crucial perspective, in fact probably the crucial perspective! But it is not the only perspective, as the realities of car production must be considered as well.

And taking these into account helps explain how the current distribution system came to be dominant, as it was not always so: in the early 1900s, in the USA at least, factories sold cars from their own stores, via traveling salesmen, and even by mail order, before evolving the franchised dealership system. And even today, in the face of incessant debate about customer satisfaction (or lack thereof) with dealers, production factors can help explain why the IND channel is dominant virtually everywhere in the world. (Even China, which had a clean sheet on which to design its new auto industry, chose to mostly replicate the Western dealership system.)

I think there are two production considerations which help push the system away from direct sales (DTC) and to indirect sales channels (IND), and neither has anything directly to do with the customer's needs and wants. These are supply-side issues.

1. IND buffers TOTAL production. The break-even point for any car factory is about 80% - even Tesla Fremont. Thus the factory wants to run as close as possible to full, all the time. Good research from the International Motor Vehicle Program also shows how the capacity/cost relationship is not 1:1: dropping a factory from running 100% full to 50% of capacity results in costs dropping only by about 20%, since cutbacks trigger massive and costly ripples through the whole supply chain. Intermediary-owned inventories buffer the factory from total demand fluctuations (which can be triggered by bad weather, holidays, income tax refunds

arriving, recessions, etc.) in terms of both volume and revenue. In down-cycles independent intermediaries load up on inventory, and step up sales efforts; in up-cycles their inventory dwindles, and they shift to order-taking. In down-cycles intermediaries' profit margins fall, and in up-cycles they rise. In terms of both units and dollars, the IND channel acts as a flywheel or buffer for the OEM. In short form, the IND channel allows the factory to supply cars at an optimal cost point, even as demand whiplashes up and down.

2. IND buffers MODEL production. Every car company sooner or later makes a clunker of a model. It is hard to quickly cease or reduce production of these (ask suppliers how big the penalty payments can be for slashing promised volumes of ordered parts). IND systems (and no intermediary or OEM will *ever* say this in public) can more effectively move the metal than the DTC system can. Yes, often they do this by selling the customer something *the customer does not want*. No argument there. But if the factory has Edsel's rolling off the line at 60-second intervals day and night, it will thank God there are intermediaries getting them sold. The question is, why are intermediaries better at doing this than DTC factory stores or websites?

Independent intermediaries can more effectively execute PD

Customers cringe at the word "discrimination," because they sense that it prevents them from getting what they consider a fair price – under PD different customers pay different prices. And since customers don't know what a fair price for a car should be, they define it as "what the other guy paid." (The joke goes that customers don't necessarily mind paying MORE for a car, only to be sure that no one else paid LESS.) And so DTC companies like Tesla generally go with "one price, posted, same for everyone." Zero price discrimination. But with IND channels, you can execute PD, which may strategically be unwise (customers don't like it and so may migrate away from the PD-ing brand) but which tactically, over the short run, be very valuable. Especially when demand is below supply. Let's look at examples, to make this clear.

Assume a DTC system. Take rising demand (D), greater than supply (S). Assume a car sells for $100, we are selling 10 units, and our break-even volume is 9. Let's say demand

is for 11 or more. We have the ability now to issue an across-the-board price hike to $110, we sell 11 units at the level, revenue goes from $1000 to $1,210, and there is joy at HQ!

But the reverse dynamic holds, also.

Take falling D, now below S. We are at $100, we are selling 10 units, demand at that point is for 10 or less, we are perilously close to factory break-even. So we issue an across-the-board price cut to $90, we sell all 10, revenue falls from $1,000 to $900, ugh. This is what has been happening to Tesla. (In the language of economics, when pricing is direct to the customer from the factory, and so completely transparent, the marginal price becomes the average price instantly.)

But if we had an IND system, we could leave the price at $100 and give the channel (dealers, agents, fincos, salespeople, etc.) a $5 payment, which they could apply in whatever way would get the car sold. If customer A will pay $100 anyway, the channel pockets $5. If customer B would pay $100 but thinks his trade-in is worth more than the market does, the intermediary can give her a $2 over-allowance on the trade. If customer C would pay $100 but can't swing the monthly payment, the finco can subvent his interest rate. &c., &c. Thus we get 10 cars sold for a net $95, and revenue is $950, which is not so bad. Marginal price does not become average price.

Thus we avoid what some used to call "The million-dollar Taurus:" a visible across-the-board $1,000 price cut to sell the 1,000th Taurus flows instantly to the other 999, whose customers have now received almost a million bucks' worth of discount they didn't need. I don't know how valuable price discrimination is. But in the last half-century or so, with S above D almost continuously, the ability to execute PD helps explain why in almost every country OEMs use IND: intermediaries such as dealers can move the metal more efficiently than the OEM. Then, in the last few years, with D above S for various reasons, OEMs fall in love with DTC. If S moves back into line with D, we shall see if this particular worm turns.[22]

[22] A colleague put it to me bluntly: "When D is greater than S, *any* sales system will work. You could auction cars, raffle them, drop them from

We can see in today's real world a clear example of DTC's inability to do PD, in the case of Tesla. As demand for Tesla vehicles softens (slightly!), to sell 1 more Model Y the company must cut the price to 10,000 other model Ys, because there is no channel intermediary willing to share this particular burden, via localized, tailored PD.

Again, in the long run, *strategically*, I won't assert that DTC is better or worse than IND. In fact my bias is for a blended system[23]. (Most OEMs do this already in a limited way: retail sales tend to be IND and fleet sales DTC.) But *tactically*, over any short term, IND can both execute price discrimination more effectively (as the salesperson (often aided by IT) assesses each customer's willingness to pay) and more efficiently (with targeted rather than across-the-board discounts).

blimps. But when D falls below S, then you need to enlist a fleet of highly motivated intermediaries, to make the factory's problem go away."

[23] Many other retail industries do this: Starbuck's has owned and licensed stores, McDonald's has company and franchised stores, Apple sells phones directly and via phone companies. But in automotive we seem to have a unique fascination with finding *the one winning way*, rather than with tailoring channels to circumstances.

About Michael L. Sena

Through my writing, speaking and client work, I have attempted to bring clarity to an often opaque world of highly automated and connected vehicles. I have not just studied the technologies and analyzed the services. I have developed and implemented them, and have worked to shape visions and followed through to delivering them. What drives me—why do what I do—is my desire to move the industry forward: to see accident statistics fall because of safety improvements related to advanced driver assistance systems; to see congestion on all roads reduced because of better traffic information and improved route selection; to see global emissions from transport eliminated because of designing the most fuel efficient vehicles.

This newsletter touches on the principal themes of the industry, highlighting what, how and why developments are occurring so that you can develop your own strategies for the future. Most importantly, I put vehicles into their context. It's not just roads; it's communities, large and small. Vehicles are tools, and people use these tools to make their lives and the lives of their family members easier, more enjoyable and safer. Businesses and services use these tools to deliver what people need. Transport is intertwined with the environment in which it operates, and the two must be developed in concert.

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