Bob Kruse: Bullish About Electrification

GM’s Former Top EV Car Exec Starts EV Consulting LLC

Anyone who’s not completely convinced that the automotive industry is in the midst of a revolutionary changeover to electrically powered traction should spend ten minutes with Bob Kruse. Mr. Kruse helped create GM’s range extended vehicle, the Volt, which will start shipping to dealers a year from now.

Mr. Kruse left General Motors on September 30 and started EV Consulting LLC on October 1. “I had been doing some homework and was ready to go,” he told me recently.

“Whether it’s battery electric vehicles, hybrid electric vehicles, range extended vehicles or fuel cell electric vehicles, the time has come. We are seeing an almost universal migration toward vehicle electrification,” said Mr. Kruse.

“Even if you disregard the need to limit CO2 emissions, when you consider the expected growth in personal transportation in the emerging markets you realize that it will be nearly impossible to meet the expected demand with petroleum. There needs to be another energy source. Electrical energy is the most abundant and diversified source of energy on the planet.”

Mr. Kruse is excited not only about energy utilization but also about what electrification means to vehicle dynamics. “Once you have an electric infrastructure in the vehicle, imagine being able to electrically deliver torque independently to all four corners of the vehicle. As you go around a corner, the electronic control system will spin the outside wheel faster than the inside wheels. The consumer gets more performance.

Google Makes Automotive Connections

Continental Sees Role for Android

A year and a half ago Weiland Holfelder left his job as chief technical officer of Mercedes Benz Research Labs in Palo Alto, California, to form a small Google automotive group in Munich, Germany, whose main objective is helping companies worldwide develop solutions to bring Google content and services into cars. “What we are providing in Munich, which is nearby some of the most innovative carmakers—Audi, BMW and Mercedes—is one face to the customer,” said Dr. Holfelder. “If the auto industry has a request to Google, we are the group to talk to, and we have the engineers that most likely can help.”

When Google takes an interest in the automotive market, you notice. With $22 billion in sales in 2008, Google is very big even by automotive standards, and it is a company whose moves can easily upset the intensely competitive infotainment market. The company’s October 27 announcement of its Google Maps Navigation product led to an 18% drop in Garmin’s stock and a 21% drop in TomTom’s stock the following day.

Garmin and TomTom make portable navigation devices for which smartphone navigation applications are a convenient substitute.

Google Maps Navigation, an Internet-connected navigation service with voice destination entry, turn-by-turn voice guidance and traffic information, is available for free to users of smartphones that run Android 2.0, Google’s own computing platform for mobile phones.

Embedded infotainment system suppliers, who have seen their prices under attack from PNDs that cost as little as $100, will see further price erosion as smartphones capable of running Google’s navigation application proliferate.

On November 6, Verizon Wireless started selling the Droid smartphone from Motorola for $199, the first smartphone to run Android. In addition to free navigation, Droid provides Internet search by voice. It also provides email, a video camera, access to thousands of applications, two keyboards and much more.

Google is not entirely new to the auto industry. In September 2007, BMW launched Google Local Search, which provides fresher data than systems that use POI (points of interest) databases stored onboard the vehicle. Google is also working with PND makers TomTom, Garmin, Navigon and others to provide Google Search on their connected portable navigation devices. “In addition, BMW, Mercedes and Renault already offer the ‘Send to Car’ feature, which lets users send Google Maps from their personal computer to their car. Then they don’t have to print their search results and re-enter the destination in their car’s navigation unit,” explained Dr. Holfelder. “We are working with many other OEMs to bring that live.”

Google has turned its attention to the auto industry with the expectation that as more drivers use Google content and services, Google can charge more for advertising. Dr. Holfelder told us, “Google has lots of other automotive projects in the pipeline, some of which I can’t talk about because they are not yet launched. But if you look at the list of geo-relevant information we already have—whether it’s Street View, whether it’s Satellite View, Panoramio, or other types of geographic information that would be nice to have in the car—those are all things we are willing to offer the automotive industry.”

Panoramio displays geo-tagged photos that can be viewed on Google Maps.

Turn to Kruse, page 8

Turn to Google, page 2
Google...

Continued from page 1

Potentially a further incursion into the market served by embedded infotainment systems providers, Google can also provide music. Google Discover Music lets users search for artists, albums, songs, and lyrics and provides links to partner sites where songs can be previewed and purchased. Google Internet radio partners include imeem, Lala, MySpace, Pandora, and Rhapsody.

Android

In order to provide content and services to people in their vehicles, Google needs a fast wireless data connection to the smartphone, PND or head unit. According to Dr. Holfelder, Google is agnostic about which operating system is used in the mobile computing platform as long as the system is open to Google products. Nevertheless, “Google is very much encouraging companies to look at Google Android for automotive platforms,” he told us. “We are extremely satisfied with the uptake and success that Android has enjoyed over the past 18 months since it was launched. Almost all our resources are going in that direction.” Android is a free, open-source mobile operating system based on a Linux kernel that enables faster and easier access to the Web from any location.

Google doesn’t see itself as the right partner to develop an automotive grade version of Android. That work is being done by Continental AG, one of the world’s largest automotive parts makers. “Android is an open-source offering, something the auto industry has a hard time dealing with if there is not a middle man who offers stable release processes and support,” said Dr. Holfelder.

Continental’s AutoLinQ Platform

Based on Android

In June 2009, Continental announced that it had begun development of AutoLinQ, an Android-based “next generation in-vehicle infotainment and connectivity solution that will enable drivers and passengers to ... safely download information and content from the Web to the dash.” AutoLinQ can also communicate with vehicle sensors and control systems through a carmaker-authorized gateway, enabling functions such as remote door locking or unlocking, checking fuel level and tire pressure, locating the vehicle and many more, via a smartphone, PC or any connected device. Continental expects to be able to leverage a community of Android developers that will develop hundreds of applications useful to people in and out of their cars.

At the end of November, Continental expects to publish a set of vehicle-specific APIs (application programming interfaces), extensions to the Android APIs, which will let the Android development community get to work on applications that make use of information from the vehicle. By early next year Continental will set up a Web site where software developers can test AutoLinQ applications on a simulated vehicle.

Brian Droessler, vice president of strategy and portfolio for Continental’s Infotainment and Connectivity business unit, talked to us recently about the AutoLinQ concept. “We see AutoLinQ as a connected services platform. That doesn’t necessarily mean Internet [browsing] in the car; it means safe access to relevant driving information and entertainment features. That can be done through downloadable applications, similar to the iPhone model, or the platform could link to a Navteq server, or to a server from a telematics provider like ATX.”

Like Google, Continental is also agnostic about operating systems. It still has a relationship with Microsoft, which supplies a competing platform. And it is a member of the Genivi consortium, which is developing yet another competing platform, one based on Linux. Continental aims to supply whatever infotainment or telematics platform the carmakers want. “With AutoLinQ, we wanted to take advantage of the community of Android developers to create new use cases and applications that we don’t have enough R&D to create ourselves,” explained Mr. Droessler. “We didn’t think that was feasible with Harman’s QNX operating system, or with a Linux-only system or with a Microsoft-based system.”

Telematics a New Way

With AutoLinQ connections to vehicle systems and the Web, it is possible to provide many of the features that are presently delivered by traditional service providers such as OnStar. “You don’t necessarily need to pay a telematics service provider $30 per month to bring these kinds of features to the car; no server in the middle is necessary,” suggested Mr. Droessler.

Google’s Dr. Holfelder agrees with that assessment. “In the U.S. telematics was a service business relying on upfront fees and call centers. That approach has not worked in Europe. I think connectivity needs to be a given. Then everything provided on top of that needs to provide value, without extra charges for services. As soon as you offer things like Google Local Search and you don’t actually charge for it, you ask the user maybe to bring in the connectivity with their phone, tether it to the car, that is a cost [for a data plan]. But the value they see is so much higher that they don’t worry about the additional data charges. That’s Google’s value proposition. It has nothing to do with the old thinking of telematics services.” Ninety-seven percent of Google’s revenue in 2008 came from advertising. You can reach Dr. Holfelder at holfelder@google.com.

THE HANSEN REPORT
ON AUTOMOTIVE ELECTRONICS

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Features and Functions in 2010

Consumers looking for small, fuel-efficient transportation in 2010 don’t necessarily have to give up all the comfort and safety features they are accustomed to in larger, heavier vehicles. Many features and functions that debut at the high end of the market eventually trickle down-market to entry-level, basic-transportation models.

Ford, Toyota, Nissan, Mitsubishi and Mini, plus Tesla and numerous other small startups, plan to introduce electric or plug-in hybrid cars in the U.S. by 2011. Chinese carmakers have EVs on the road and plan to bring imports to the U.S. in the next few years. Nissan’s Leaf plug-in electric vehicle will become available in Japan, Europe and the United States in late 2010. The Leaf will have a 100-mile range when fully charged, LED headlamps and an advanced IT system that will provide “support, information and entertainment 24 hours a day,” according to Nissan. Leaf owners will be able to turn on their air conditioner and program battery recharging times via their mobile phones. Nissan will produce its own motors and inverters.

The all-new 2010 Opel Astra compact, introduced at the 2009 Frankfurt Auto Show, offers plenty of high-end features, but most are fairly high-priced options. For instance, a Bosch CD 500 Navisystem with seven-inch color display is available for 815 euros. FlexRide adaptive suspension is a 450-euro option on the Astra, and a 700-euro lighting option provides adaptive forward lighting, bi-xenon headlamps, LED daytime running lights, high beam assist and headlight washers. The Opel Eye front camera system (from Hella) that came out on the Opel Insignia last year is now available on the Astra as well. Opel Eye recognizes traffic signs, reads speed limits and enables lane departure warning. BMW introduced a similar system last year.

In the midsize sector, cross-path detection systems on Chrysler minivans and Ford Taurus and Fusion sedans use radar to warn the driver against backing out into the path of an oncoming vehicle. The driver is alerted with an audible warning, and a flashing signal on the appropriate outside mirror indicates from which side traffic is approaching. Radar adaptive cruise control (from Delphi), collision warning and blind spot warning are available options on some 2010 Taurus models, a first for its class, according to Ford.

The City Safety collision avoidance feature, standard on the 2010 Volvo XC60 crossover, provides automatic braking at speeds from two to 18 miles per hour. The system uses an infrared laser mounted near the rearview mirror to monitor the distance to the vehicle ahead. The infrared sensor and braking system are from Continental.

While premium carmakers are touting their vehicles’ fuel efficient four-cylinder gas and diesel engines, hybrid versions and electric concepts, they also compete for luxury vehicle buyers with sophisticated active safety, convenience and entertainment features. Lane keeping assistance is replacing lane departure warning. Improved night vision systems can better identify pedestrians in the vehicle’s path. Multiple airbags improve crash protection for all occupants in front, rear and side impact collisions and in rollovers. Ten bags are standard in the 2010 Lexus HS 250h hybrid. The new Mercedes E-Class comes with nine airbags, including for the first time, according to Daimler, pelvis protecting bags for the front occupants.

Attention Assist drowsy driver warning is standard on the 2010 E- and S-Class Mercedes. Sensors monitor the driver’s steering behavior across 70 parameters. If the system detects drowsy behavior it sounds a warning and displays a coffee cup icon in the instrument cluster.

Mercedes’ mbrace telematics service, launched with Hughes Telematics, connects owners with their vehicles via iPhone or BlackBerry and provides 18 safety and convenience services such as automatic collision notification, stolen vehicle assistance, navigation and remote door unlocking. Mbrace replaces the Telaid service on all new Mercedes sold in the U.S. Service is provided free for six months; after that the annual subscription fee is $280.

The optional front-seat entertainment package on the S-Class includes the Splitview display, developed with Bosch, which allows the driver and front passenger to view different content on the center eight-inch TFT-LCD.

New on the 2010 Toyota Land Cruiser launched in Japan in September is the Multi-terrain Monitor, which gives drivers venturing off-road a better view of where they’re driving. A world’s first, according to Toyota, the monitor displays images of ground conditions around the vehicle from four onboard cameras. A wheel position display in the instrument panel indicates the angle of the front wheels.

GM is offering an Autonet Mobile WiFi router in several Cadillac, Buick, GMC and Chevrolet models as a dealer-installed option for $499 plus a $29 per month subscription fee. Autonet routers are also offered in some Chrysler and Volkswagen models. Mercedes is testing mobile Internet over a 4G wireless high-speed LTE (Long Term Evolution) network for future generations of its models.
Please see the October 2009 Hansen Report for Part One of the Delphi Company Profile. Last month we profiled the new, post-bankruptcy, privately-held Delphi and started a closer look at the Electronics and Safety division. We continue with Electronics and Safety, as well as the Powertrain, Electrical/ Electronic Architecture, and Thermal Systems divisions, and find out where they are focusing their innovation efforts.

Delphi Electronics and Safety

Headquarters: One Corporate Center, Kokomo, Indiana; Tel. 248-813-2334
2008 Sales: $4,048 million
Operating Loss: $354 million
OIBDAR*: $70 million
Major Products: Radio (terrestrial and satellite) receivers; navigation and antennas; passenger occupant detection sensors; body computers
“Operating income before depreciation, amortization, transformation and rationalization charges and discontinued operations

Delphi is working on the next great innovation in car radio: software defined radio. Rather than using hardware designed for a particular radio protocol, radios will employ general purpose processors capable of digitally processing a variety of coding and modulation protocols. “In the future you will have a couple of different RF chips to handle the different frequency bands. But then all the processing will be done in a separate digital baseband chip that will have all the software, all the algorithms to demodulate and process whatever broadcast technique is used.

“There are no pure software defined radios out there today. This is an innovation we are working on that I believe will go across all automotive radios, really all communications systems over the next ten years,” predicted Dr. Schumacher.

Delphi Electronics and Safety Products

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Electronics and Safety. “We know that because we test our radios against the competition in our digital reception lab here in Kokomo. We test them under low signal conditions, under multipath conditions, and under conditions where you have a very strong station next to a weak station.” Using recordings of radio signals taken while moving through the Sepulveda Pass in Los Angeles, California, for example, Delphi can simulate in the lab one of the most difficult high-multipath reception conditions in the world.

Delphi employs digital tuner modules from NXP Semiconductor that run exclusive Delphi algorithms. “Nearly all our radios today are digital radios. We still have an analog front end but we digitize the intermediate frequency output of the local oscillator in the front end; all the processing, all the tuning is done in the DSP,” pointed out Dr. Schumacher.

Among the largest customers for Delphi radios are GM, Ford, Toyota and Volvo Truck Corporation.

Delphi also makes digital satellite radios, a U.S. market that it dominates, according to Mr. Vijay: “Since 2002 we have made close to 18 million satellite radios. We presently have 80% of the OE market.” Delphi is also developing satellite radios for the European market. The company is a minority investor in a European satellite radio startup called Ondas Media (Madrid, Spain), which has contracts with BMW, Nissan, and Renault and expects to begin satellite broadcasts in 2012.

◆ Software Defined Radio

Software Defined Radio

Infotainment Integration

Infotainment is an intensely competitive industry segment. Fifteen major tier-one players compete for business with OEMs around the world. Jugal Vijay, vice president for Delphi Electronics and Safety’s infotainment and driver interface business, explained how he sees Delphi distinguishing itself from the competition: “Price is always a major deciding factor, so we must be certain that our costs are low. But other elements are also important. We aim to be more than just a supplier to our customers; we want to be their partner. That approach was critical to our growth in China and India, where we do more than manufacture locally and write software locally. We are very close to our customers, we speak their language, we work hard to fully understand their requirements and then design and develop the product in and for the Asian market.”

◆ Digital Radio Receivers

“From a reception standpoint, we have the best radios in the world,” said Bob Schumacher, general director of advanced product and business development for Delphi. “This has allowed us to increase our market share in what is a fiercely competitive market. “We also have a strong focus on software-defined radios, which are the future of the industry. “Software-defined radios allow us to be flexible and responsive to the changing needs of our customers. “We are constantly looking for ways to improve our products and stay ahead of the curve.”

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Delphi Powertrain Systems

Delphi believes its global manufacturing footprint, as well as its regional engineering and development centers, are important competitive strengths. “We understand where powertrain development happens, and we have the appropriate resources to align with what the markets need,” said Vishy Seetharaman, Delphi Powertrain strategic marketing manager. “If you look around the globe, powertrain development happens at the high technology end—from a fuel economy perspective in Europe, because that is the key market driver there. In many cases our Asia Pacific customers prefer the sophistication offered in Delphi systems,” he said.

Powertrain Systems’ aim is to put the green in Delphi’s “safe, green and connected” product portfolio. In both the gasoline and diesel sides of the business, Powertrain has sharpened its focus on products and technologies that will enable better fuel economy and reduce CO2 emissions. Three years ago, Delphi relocated the headquarters for the Powertrain division to Europe and is working to increase its share of the diesel fuel injection market there. Delphi acquired Lucas Diesel Systems in January 2000, a move that significantly expanded its diesel expertise and product portfolio.

Diesel Fuel Injection

Among Delphi’s most successful innovations is its unique direct piezo injection system, currently on the road in Mercedes’ four-cylinder diesel engines in Europe. Delphi’s piezo injector differs from its competitors’ in that the injector needle is set in motion directly by a piezo ceramic actuator, rather than being moved by an electro-hydraulic circuit. According to Delphi, the elimination of the conventional hydraulic servo mechanism provides far better injection control, resulting in lower emissions, more power and improved fuel economy. The technology also fits well with start-stop systems. It enables faster restarts by maintaining stable rail pressure when the engine is stopped.

Spray-Stratified Gasoline Direct Injection (GDI)

On the Gasoline Engine Management side of the business, Delphi is developing the next generation in its line of Multec direct injection systems. Multec 20, scheduled for production in 2012, is an outwardly opening solenoid injector that Delphi claims can deliver the same benefits and performance of piezo injectors, but at lower cost. “What is really innovative about our solenoid GDI for homogeneous engines is that it is a really low-noise design; it generates less mechanical noise and less hydraulic noise,” explained Mr. Fuerst. In addition to providing cost savings by eliminating the need for noise abatement designs and cladding, spray-stratified or lean burn GDI improves the efficiency of the engine and is another step OEMs can take toward meeting future CO2 emissions targets.

Powertrain Systems Products

Gasoline Engine Management Systems
GDI (gasoline direct injection) spray stratified injection
GDI for homogeneous mode
High energy and multi-charge ignition systems
Variable valve timing
Variable valve lift
Engine control modules
Transmission controllers
Small engine electronic fuel injection systems
Ethanol compatible fuel systems
Exhaust sensors
Fuel Handling and Evaporative Emissions
Complete fuel systems
Fuel modules
Evaporative emissions systems
Carbon canisters
Active scrubbers
Diesel Engine Management Systems
Direct acting injection common rail systems
Solenoid common rail systems
Electronic unit injectors
Electronic unit pumps
Heavy duty common rail systems
Dimethyl ether system
Unit pump common rail for small engines
Diesel engine controllers
Smart remote actuators

The Company Profile Continued
Delphi (Part Two)

Delphi Electrical/Electronic Architecture (E/EA)

Founded by the Packard brothers in 1890, the business now named Delphi Packard Electrical/Electronic Architecture has been producing electrical cables since 1901. Packard Electric was acquired by General Motors in 1932 and became one of the six divisions that made up Delphi Automotive Systems when Delphi was spun off by GM in 1999.

Ninety-five percent of Packard's sales are for light vehicle applications; commercial vehicles account for about 80% of sales. Connectors and electrical centers, 20%

Top Customers: GM, Ford, Volkswagen, Daimler Fiat, Toyota

Packard Electrical/Electronic Architecture Sales by Year

2006 to 2008 CAGR: 2.6%

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<thead>
<tr>
<th>Year</th>
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<tr>
<td>2006</td>
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<td>2007</td>
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Delphi relies on its proprietary Velocity suite of design, analysis and simulation tools, partly developed in house and partly off-the-shelf tools that Delphi has modified. “Velocity is the enabler we needed to continue to enhance our E/EA capability,” noted Steve Duca, Delphi E/EA global director of engineering and operations. “It lets us start with designing and optimizing an architecture, and then have those requirements flow down through detailed component design, design analysis, and right into the manufacturing systems.”

According to Mr. Duca, Delphi has been able to reduce wiring harness mass in the range of 20%, to reduce cost by 35% to 40%, and improve reliability and functionality in the 20% to 30% range by using Velocity tools.

Delphi is working on new wiring products designed to reduce mass and use more environmentally friendly materials. Among them are halogen-free cables, smaller gauge wiring and aluminum alloy cable for both battery and primary wiring. While aluminum battery cables have been used for several years, Mr. Duca sees potential for aluminum alloy increasingly replacing copper wiring, as long as copper prices are high enough for carmakers to justify making the change. “We’re basically at that crossover point now,” he said. “That’s why we’re working on it.”

Halogen-free cable replaces the polyvinyl chloride (PVC) insulation used in copper cables with a nontoxic alternative. Delphi realized additional benefits: the new insulation reduced the wall thickness of the cable, resulting in a 27% average weight reduction and 47% average volume reduction compared with thin-wall PVC cable. Smaller connectors can be used with the halogen-free cable, and it is a physically tougher, more robust product.

“I've got a cable today that is smaller, lighter, tougher and it’s green,” Mr. Duca remarked. Delphi uses halogen-free wiring in approximately 25% of the applications where it is a viable substitute. In the future halogen-free wire could represent 85% to 90% of Delphi's cable production.

Delphi Packard E/EA

E/EA Distribution Systems
- Primary wiring harness assemblies
- Ignition wiring
- High power wiring assemblies
- Cable
  - Halogen-free ultra-thin
  - Small gauge high strength copper alloy
  - Aluminum core
  - Battery cable assemblies

Connection Systems
- Standard automotive
- Device connections
- Data connectivity
- High power/high performance
- Hybrid
- Commercial vehicle
- Military/aerospace
- Non-circuit bearing
- Electrical Centers
  - Battery, interior and underhood

Delphi’s high-speed digital data (HSDD) cable assemblies and connectors link vehicle data systems to consumer electronics and can be used in high-speed data applications such as camera based systems for both passenger and commercial vehicles. They are compatible with a range of high speed protocols including USB, 1394, LVDS, FlexRay, eMOST and Ethernet.

Most Promising New Products

- Hybrid E/E Connection Systems
  Delphi currently supplies the full wiring harness on the Ford Fusion hybrid. It has successfully leveraged its experience with highly ruggedized connection systems for the U.S. military in both the hybrid and commercial vehicle markets. “We were able to transfer military technology into the automobile, which gives us a unique advantage in medium and high voltage connection systems—very low engagement force, very high current, very ruggedized connections,” said Mr. Duca.

- Data Connectivity Products
  In 2005, Delphi began supplying Fiat with USB ports for consumer electronics devices. Today Delphi has more than 700 data connectivity products including a wide range of automotive grade consumer ports such as USB hubs, RCA jacks and card readers, as well as all the associated cabling and connectors. The company sees the market for data connectivity products expanding at the rate of 50% to 70% annually.
The Company Profile Continued

Delphi Thermal Systems

Delphi’s Thermal Systems business was founded in Lockport, New York, as the Harrison Radiator Company. A pioneer in powertrain cooling and automotive HVAC, Harrison manufactured the first underhood automotive air conditioning system in 1954. HVAC systems and controls remain Delphi Thermal’s largest product segment today, followed by compressors, powertrain cooling, and the non-automotive stationary air conditioning and refrigeration systems, the smallest but fastest growing product line. Thermal Systems provides both components and complete systems, including HVAC modules, controls, software and calibration service, to a wide range of customers from Japanese luxury carmakers to small carmakers in emerging markets who still lack complete systems capability.

In 2010, about 90% of Thermal Systems’ sales will come from automotive customers, with the remaining 10% coming from customers such as Carrier and York (a JCI subsidiary), who serve residential and commercial HVAC markets. Ninety-five percent of Thermal Systems’ automotive sales come from light vehicle makers including GM, Volkswagen, Ford, Toyota and PSA. The remaining 5% is commercial vehicle business.

Thermal Systems’ sales are growing fastest in the Asia Pacific region, particularly in China. The division is also projecting significant sales growth in North America. While General Motors has taken some of what was Delphi’s business in house, Delphi is picking up business with Ford, Chrysler and the North American transplant

Delphi believes that carmakers are looking for an alternative supplier to Denso, the number one automotive HVAC and compressor supplier with roughly 25% to 30% of the global market. Delphi is confident its customers recognize that Thermal Systems products compare favorably to Denso’s in terms of performance, and in some cases offer better value from a cost perspective.

Electronically Controlled Variable Displacement Compressors

Electronically controlled variable air conditioning compressors are the most energy efficient compressors available today, comprising nearly 100% of the compressor market in Europe. Given the global focus on fuel economy and reducing greenhouse gases, Delphi sees carmakers in other markets increasingly turning to electronically controlled variable compressors. North American carmakers have historically opted for the lower cost, fixed type compressors, which run continuously. Steve Kiefer, Delphi Thermal Systems director of engineering, estimated the North American market today is split roughly in half between variable and fixed types.

While fuel economy improvements with variable compressors are measured in just tenths of a mile per gallon, Mr. Kiefer said the more precisely controlled variable displacement products provide good value, despite their additional cost. “The ability to have complete electronic control of the stroke of the compressor means you can minimize the time you are using the compressor. And we are incorporating it into the vehicle architecture and the HVAC system, meaning we can control to a more desirable evaporator-out temperature,” he explained.

Traditionally the passenger air is cooled to a very low evaporator temperature and then rewarmed to the desired comfort level. “If you can minimize the amount of cooling that you do, then you further reduce the compressor use,” Mr. Kiefer added.

Charge Air Coolers

Delphi first started producing charge air coolers in 2006 to take advantage of the robust diesel market in Europe. Mr. Kiefer predicts that as the industry moves toward more downsized turbocharged gasoline engines, penetration of charge air coolers will increase dramatically.

“We have brought a lot of material and geometry benefits that address the problem of internal and external pressure drop,” Mr. Kiefer said. “We have engineered specific designs for specific applications for our customers, and that capability has been valuable in winning business.” Delphi Thermal has advanced engineering work ongoing to improve cooling of not only the induction charge, but also cooling the re-circulated exhaust gas. Delphi is working on next generation products that will use liquid coolant rather than ambient air to cool the charge air.
“There are few times in your life when you can spot a trend. There are fewer times when you are properly positioned to take advantage of that trend. And there are even fewer times when you actually have the courage to do something about it. That’s why I have set out on my own,” explained Mr. Kruse, who is 50 years old.

Mr. Kruse sees tremendous business opportunity everywhere he looks—up and down the electric-vehicle value chain. “A lot of money is being invested in batteries, but the inverters, chargers, and electric machines also need to be cost reduced and simplified.

“What we are seeing now with electrification is all this stuff getting added to conventional vehicles, and that adds complexity. The real opportunity will come by integrating and simplifying the overall vehicle,” he said.

Vehicle Electrification Challenges

As it is with almost all new technology, cost is the greatest obstacle for electric vehicles. The greatest challenge in bringing the Volt to market was making the business case for it. The business model not only depends on the vehicle’s cost, but also its value to consumers, based largely on the price of oil, which has fluctuated wildly. “Low petroleum prices are not a good enabler for vehicle electrification,” noted Mr. Kruse. Over the long term, with petroleum supplies fixed, the price of oil is bound to go up.

Thermal management and noise management are especially challenging aspects of electric vehicle design. “The automobile has to operate from minus 40 to plus 100 degrees Fahrenheit. So the operating temperatures of the battery, the electric machines and the power electronics all must be carefully managed, because high temperatures severely limit life,” said Mr. Kruse. “The thermal management systems of electric vehicles are very complex, second only to the complexity of the electrical systems.”

Because the engine isn’t running all the time, noises aren’t masked as they are in a conventional vehicle. There is less background noise. “You hear the road noise, the rush of refrigerant through the evaporator behind the dash, or the refrigerant running through the battery compartment, or the cooling pump, or the HVAC blower. Even when the engine starts, since you are not used to hearing it, it can be a problem unless it runs very quietly. These things also require attention,” said Mr. Kruse.

Extended Range Vehicle Makes Most Sense

Mr. Kruse believes that given the state of the art of battery technology today, there is a sweet spot in the market for range extended electric vehicles like the Volt. They have enough battery power to meet most drivers’ daily mileage needs, but they also have an internal combustion engine running a generator to address what Mr. Kruse calls range anxiety. “Seventy-eight percent of the U.S. driving population drives 40 miles a day or less, so why carry around a big, expensive 200-mile battery? The heavier battery means you need more structure to carry it, bigger brakes to stop a heavier car—the problem cascades throughout the vehicle. I believe you will see much of the industry migrate to this range extender solution,” he predicted.

Technology Advancement Inevitable

Western governments have been heavily incentivizing advanced battery development and, to a lesser extent, power electronics and electric machines. “Back in the EV1 days, it took 1,200 pounds of lead acid batteries to equal 16 kilowatt hours of energy. [GM’s electric vehicle, the EV1, was launched in 1997.] Today only 400 pounds of lithium ion batteries deliver the same 16 kilowatt hours of energy,” Mr. Kruse noted.

“There is an equivalent of Moore’s Law that applies to batteries, to power electronics, to electric machines. It may not be the same slope as with semiconductors, but the trend is irrefutable,” he said. Development of alternatives to lithium ion batteries are already well underway.

Demand Coming from China and India

While there is tremendous global momentum toward electrification, Mr. Kruse believes the real opportunities for carmakers and parts makers will come from the emerging markets, where demand for personal transportation is growing most quickly. Asian nations, particularly China and India, are already building up an electric infrastructure to support the coming boom in electric vehicles.

“What is happening in electrification is normal and typical for the automobile industry,” Mr. Kruse observed. “Advanced technology is introduced in high-end vehicles in the developed world, and eventually migrates to the broader markets. You are seeing lots of government incentives and focus and policy trying to jumpstart that right now.”

Features...

myCOMAND infotainment system. The 2010 Peugeot 5008 minivan can be fitted with a WiFi unit that accepts the owner’s SIM card.

Managing driver distraction and the human machine interface continue to be critical components of infotainment. The use of voice commands for information and entertainment functions is expanding. BMW and Mercedes are both employing Nuance Communications’ One Shot Destination Entry voice recognition product that lets users say a complete destination address in just one step rather than wait for individual prompts for number, street and city.

On navigation-equipped models of the 2010 Lexus HS 250h hybrid for the U.S., a casual, language-based voice recognition system lets the driver give fewer and more flexible commands to control the audio, climate and navigation systems. A head-up display shows speed, navigation turn arrows, driver assist warnings, audio info and an image of the steering wheel mounted switches. A driver attention monitor, part of the technology package option available only on the Premium model, uses an infrared camera to monitor the direction of the driver’s face.