Fiat and Chrysler Top EEs Swap Jobs

Alan Amici to Fiat; Bruno Antonioli to Chrysler

In July 2009, shortly after Fiat took control of Chrysler, Alan Amici, then Chrysler’s top EE, and Bruno Antonioli, then Fiat’s top EE, began working closely together. In two years they have accomplished quite a lot toward integrating the work of the two electrical engineering organizations. “Each team has been contributing best practices to the united effort,” said Mr. Amici. “We are in the process of adopting some of the same tools. And we are well on our way toward sharing components.” The two executives swapped positions on September 1, 2011, with Mr. Amici moving to Turin, Italy, and Mr. Antonioli moving to Auburn Hills, Michigan.

“Swapping positions will allow us to integrate even faster,” Mr. Amici said. “Bruno is able to take a fresh approach at Chrysler, and I can do the same at Fiat.”

“Our standards, procedures and specifications are already aligned, as are more than 90% of our processes,” said Mr. Antonioli. Mr. Amici is responsible for the development of electrical and electronics systems for every vehicle domain at Fiat with the exception of powertrain. Mr. Antonioli covers everything at Chrysler except powertrain and infotainment.

Common Architecture

More than a year ago, the companies set up a team of electrical engineers, some from Europe, some from the U.S. and some from Brazil, to develop a common electrical architecture that will allow Fiat and Chrysler to develop and share common components. The first vehicle based on the new common electrical architecture that will allow Fiat some from Brazil, to develop a common electrical architecture that will allow Fiat some from Europe, some from the U.S., and common components. The first vehicle based from Brazil, to develop a common electrical architecture that will allow Fiat some from Brazil, to develop a common electrical architecture that will allow Fiat some from Europe, some from the U.S. and common components. The first vehicle based

ISO 26262 Taking Hold

Functional Safety for Automotive Electronics

Still in draft form for another several weeks, ISO 26262, the Road Vehicles Functional Safety standard, which defines the state of the art of automotive electronics safety engineering, is already being taken very seriously by carmakers worldwide. If they aren’t adopting it outright or making sure their existing safety systems are at least as good, they are certainly studying whether they will and how soon.

Anybody still on the fence about the standard will look to balance the costs to implement it against its very compelling benefits. Applying the standard will almost certainly help carmakers produce more reliable cars, cars that are even less likely to kill or injure people. Following the standard will also help carmakers and their suppliers make a well-documented safety case that they did everything the state of the art required without over-spending on things that don’t measurably improve safety. And further, the standard will make safety engineering easier for suppliers, who today must respond to requirements that vary from carmaker to carmaker.

Developed by and for manufacturers of mass-market road vehicles and their suppliers, ISO 26262 supports safety throughout the vehicle’s life cycle, from development to decommissioning. Rigorous and robust, it embraces the entire EE development process for hardware and software, even model-based design, from requirements to integration, verification, validation and configuration. The standard addresses all safety-critical systems and the hazards that can result. Safety-critical systems are those that have the potential to cause physical harm if they fail in their intended functions.

The impact of ISO 26262 on carmakers and suppliers depends on how far it stretches their safety organizations and processes from where they are today. “If you had a robust process in place that you’ve developed over the years, like we have, then ISO 26262 will not be much of an upheaval at all,” said David Hartfelder, engineering group manager at General Motors and chairman of the SAE Product Safety Committee. “We’ve definitely added people to some of our programs, not so much because of the ISO standard but because of the proliferation of safety-related features. For instance, the penetration of power steering assist systems five years ago was much less than it is today.”

For companies without a rich safety engineering legacy, the investment to come up to speed on ISO 26262 will be significant. Guido Sandmann, automotive marketing manager for MathWorks, observed: “Companies will have to define new roles and adapt their development processes. They will need more people, including quality engineers, to assess and monitor their suppliers, and they will need training.”

Safety Engineering

Safety-related engineering as prescribed by ISO 26262 requires significantly more effort compared to non-safety-related projects of the same complexity. The engineering effort needed to achieve an acceptable level of residual risk for a system varies depending on assigned ASIL (Automotive Safety Integrity Level) risk classes, with A representing the lowest risk and D the greatest.

<table>
<thead>
<tr>
<th>ASIL</th>
<th>Effort Increase*</th>
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<tbody>
<tr>
<td>A</td>
<td>5%–20%</td>
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<td>B</td>
<td>10%–35%</td>
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<td>D</td>
<td>40%–100%</td>
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*If the project team is already well prepared to handle complex safety-critical systems, increased effort would be at the lower end of the range.

Source: Kugler Maag

Turn to ISO 26262, page 2
ISO 26262...

The engineering tools carmakers and suppliers use to engineer safety systems will also have to be qualified in light of ISO 26262. “You need to demonstrate that the tool can be used in these kinds of projects,” said Mr. Sandmann. “Tool qualification is a very time consuming process.”

According to Mecel AB safety manager, Hakan Sivencrona, companies seeking ISO 26262 compliance should start with a pilot project and be willing to make an investment well beyond the project’s scope. “If you use this project as a way to develop your company’s processes, then you will have big benefits.”

Market Effects

ISO 26262 requires that at the beginning of the development process, safety functions are analyzed and assigned a risk level, one of four Automotive Safety Integrity Levels (ASILs), using the letters A through D. The severity of potential harm that could result if a system malfunctions is greatest for systems classified ASIL D and least for those assigned ASIL A.

Depending on the system’s ASIL, compliance with the safety standard might require adding redundant components and diagnostics. “That could add slightly to the bill of materials,” said GM’s Mr. Hartfelder. “Adding a second processor to diagnose the main processor, for example, is much less expensive than it was in the past. You are talking less than a dollar for a processor of that type. And dual core processors are coming on stream to handle more functionality. These could also be used to execute a checking function that would add nothing to hardware cost.”

“The standard has driven the need for redundancy,” said Dev Pradham, Hercules safety microcontroller platform business manager for Texas Instruments. “There are several ways to get it. You could put two cores into one microcontroller, either two separate homogeneous cores running in lock step with logic running outside the core that does a comparison of the two outputs, or two cores of different types not running in lock step. Alternatively, you could have a main core and a checker CPU, external to the micro. Dual core processors cost about the same today as single core processors cost ten years ago.”

Joe Miller, chief engineer for TRW and among the contributors to the standard, agrees that more redundancy will likely be required. “The hardware requirements of ISO 26262 exceed those of IEC 61508 [the non-automotive-specific standard ISO 26262 is derived from]. Variable costs for redundancy may increase depending on the application and the ASIL.”

Who’s Pushing 26262?

According to Mecel’s Mr. Sivencrona, work on the standard began in 2004 as a German and French initiative, and was opened up in 2005 to other stakeholders. The early champions included representatives from BMW, Daimler, Volkswagen, PSA and TRW, among others. By 2006, Bosch, Continental, Renault, Valeo, Fiat, Mecel, Volvo, Nissan, Ford, GM and Delphi had joined the effort, among others.

Toyota began sending more representatives to committee meetings not long after its 2005 recall of 160,000 Priuses to fix a software problem that caused the engine to stall. When that happened the vehicle went into failsafe mode and could be driven to the side of the road powered by the electric motor, with the brakes and steering still functioning.

According to TRW’s Joe Miller, today almost every European and U.S. carmaker is referencing ISO 26262 in at least some of their RFQs, and Japanese carmakers are preparing to implement it. What the Chinese will do isn’t yet clear. Separately, top electrical engineers at Chrysler and Fiat haven’t yet been cleared to talk about the safety standard. The ISO 26262 draft has been available to the industry since July 2009.
acceleration problems and the role electronics play in safety, similar versions of the Motor Vehicle Safety Act of 2010 were introduced in the U.S. House of Representatives and Senate, but they were never voted on. “Now NHTSA is in a study phase to see if new automotive electronics safety legislation is needed,” said Mr. Hartfelder, adding, “There are many complex automotive systems being introduced in the marketplace, but with all of the ISO activity going on and the robustness that the OEMs and suppliers are putting into their processes, my position is we are pretty well covered.”

The SAE Product Safety Committee currently has 50 members representing 27 companies and six countries including carmakers in the United States, Germany and Japan. “Our objectives are global,” declared Mr. Hartfelder. “Teams from Germany and Japan have been working separately on hazard classifications and carmakers have been doing this on their own. It makes a lot of sense to bring all the expertise together and come up with one common classification for hazards.”

Using ISO 26262 as the framework, the committee will consider all system hazards to make sure they are well understood so future systems are designed to detect and mitigate any hazards before they occur. Hazards include unintended acceleration, unintended steering and unintended braking.

Hazard Classification Process

Mr. Hartfelder explained the classification process the committee will follow. “In ISO 26262 there are five levels of classification: Quality managed, which means you don’t have a safety implication; then there are ASILs (Automotive Safety Integrity Levels) A, B, C and D.”

“The classification is based on three components: exposure, severity and controllability. The exposure to the hazard asks how often you get into a driving scenario where this hazard can occur. The severity component asks, if the hazard did occur, at worst case how critical could it be? There are four levels of severity, the worst being death or serious injury. The least is there would be no injury.”

“The last piece of the classification process is controllability. For example, if there is acceleration, is it significantly beyond what the operator is requesting? Does it last a significant amount of time for the operator to become startled, and unable to take corrective action? If so, you would rate that at the highest controllability level, which means it is not controllable by some percentage of the population.”

“In safety-critical systems we use hazard metrics to differentiate performance issues from safety issues. If you are driving at 45 mph and you have a little acceleration bump that lasts 100 milliseconds, you will probably feel it, but it won’t feel any different than if you hit a pothole. However, there is a hazard metric that pushes it over the edge from a performance to a safety critical issue. An unintended acceleration that lasts longer than a certain period of time becomes a metric.”

Mr. Hartfelder expects that committee members will share the data they’ve collected over the years from universities and other sources to make the accumulated data more statistically significant. “All of us have been trying to develop the data separately and spending a lot of money. It would make a lot of sense to merge everyone’s information and come up with the ultimate result together.” The SAE Product Safety Committee expects to reach consensus on the hazards and hazard metrics in the spring of 2013.

Fiat and Chrysler EE...
Background

Marquardt was founded in 1925 by two unrelated entrepreneurs, both named Johannes Marquardt, to manufacture “electrical supplies and fine mechanics.” Their first customer was a vacuum cleaner maker. The new company began making switches in 1926, and switches remain a major product today. Marquardt expanded rapidly in Germany after World War II, and by the end of the twentieth century had manufacturing subsidiaries in Switzerland, Northern Africa, the United States and Asia. A new facility is currently under construction in Mexico.

The company began production of electronics systems for power tools in 1968, and during the following decade diversified its product line to also serve the automotive industry. Its first specialized switches for automotive applications were released in 1980.

The families of the two Johannes Marquardts still share equal ownership of the company. Harald Marquardt serves as CEO and chief technical officer, but most of the board of management members are unrelated to the Marquardts. According to Dr. Marquardt, roughly twenty Marquardt family members, representing three generations, are actively involved in the company. The financial relationships and responsibilities of the families have been strictly defined and regulated since the company’s founding.

As a private company, Marquardt is able to focus on its long term health rather than the short term bottom line. Since we last profiled Marquardt in April 2005, the company has picked up a number of new automotive customers outside of Germany, namely General Motors in the United States, Fiat in Europe, Chery, SAIC, Geely and Brilliance in China, and the Japanese truck maker Fuso. “We are much more international now, compared to six years ago,” said Dr. Marquardt.

While more than 80% of Marquardt’s business is with European carmakers and suppliers, especially the Germans, the company is making a special effort to expand its business in North America and China. In North America it focuses on two main customers: Chrysler, its largest in North America, followed by General Motors.

Keys to Success

We asked Dr. Marquardt how his company has managed to grow sales at an annual rate of 13.5% since 2004, while its served market has grown at only 9% to 10% per year during that period.

“Customers like us primarily because of our technology, but they also like our dedication and our flexibility, our expertise and overall service. And while some suppliers say yes to everything, we tell our customers not only what is possible but also what is not possible; we fulfill our promises. I think they like us for these things. Hopefully they love us. At least they come back,” he observed.

Marquardt expects double digit percentage growth in 2011 as well. By 2015 sales are projected to top one billion euro, with automotive accounting for three-quarters of the total.

Despite Dr. Marquardt’s generally sunny outlook, there are still some things he worries about. “Not only is price pres-
Distinctions Claimed by Marquardt

- World’s first producer of multifunction electronic key with display, for trucks
- World’s only remote driver authorization system supplier capable of producing all system components in house: ignition switch, control unit, antenna, door-handle sensors and electronic steering column lock
- Produced more than 10 million driver authorization systems

Vertically Integrated

One of the keys to the company’s success, according to Dr. Marquardt, is its insistence on vertical integration. Marquardt provides almost all of the added value for what it manufactures. Outside purchases account for just 50% of the company’s revenues.

“We are competent in-house in nearly all of the technologies required to build switches,” said Karl Mueller, vice president for automotive product development. “For example, we produce nearly 100% of our undecorated (unchromed and unpainted) plastic parts in house; we even do 50% of the decorated plastic parts. Marquardt builds many of its own plastic injection molding tools, and we do our own stamping. ... Most of our factories have molding departments, electronics assembly and final assembly on the premises.”

Marquardt prides itself on its ability to efficiently transfer engineering ideas into production through a combination of decades of experience in designing switches, continuous training for its engineers, and rigorous attention to development processes that ensure high quality and reliability.

Mechatronics

Many of the products produced by Marquardt exemplify its competence in mechatronics—the combination of fine mechanics, electronics capabilities and software with design. Marquardt believes its ability to produce smaller and lighter components, together with its expertise in packaging, provides a competitive advantage as carmakers focus on reducing vehicle weight even as they continue to add features and functions. “Because of our vertical integration we have a thorough understanding of the complete package, from the plastics to the software, and we can produce electronics at a competitive price,” Dr. Marquardt asserted.

Promising Existing Products

- Driver Authorization Systems

The number of new vehicle models offering keyless start as either an optional or standard feature has been growing quickly. According to Edmunds’ AutoObserver, more than half of all new cars and trucks sold in the U.S. in 2011 offer keyless start. Increased global demand has brought new customers for Marquardt, which produces in-house all the components that comprise driver authorization systems—the electronic key, electronic ignition starter switch, antennas, door-handle sensors, control devices and an electronic steering column lock—something none of its competitors can do, according to the company. Marquardt can
also provide customers with complete driver authorization system solutions. For example, it has full system responsibility for driver authorization in the new Audi A6.

**Electronic Steering Column Locks (ESCL)**

One of the company’s most appealing products is its electronic steering column lock, which locks and unlocks the steering wheel based on authentication of signals exchanged between the control unit in the ESCL and the electronic key via the CAN bus. A DC motor actuates the locking mechanism.

Marquardt’s version of the product is especially small and light weight. “We have a lot of variants, and the packaging can be customized with different motor gears to fit a variety of steering columns,” said Mr. Mueller, who is one of the device’s inventors.

Because the steering column must never go into the locked position when the vehicle is being driven, it is a safety-critical device. Marquardt’s ESCL is unique in that its design conforms to the functional safety standard, ISO 26262, without requiring that other parts of the driver authorization system also conform. With two microcontrollers in the unit for redundancy, it is intrinsically safe. Its input comes only from the CAN bus, an industry first, according to Marquardt.

Marquardt is among only a handful of suppliers offering ESCLs. “The market for our electronic steering column lock is ripe all over the world, particularly in Asia,” said Dr. Marquardt. “Customers are approaching us rather than us approaching them.” In China alone Marquardt is working on eleven different ESCL applications.

**20-Kilohertz Keyless Entry**

Marquardt’s electronic keys transmit at 20 kilohertz. This provides a number of advantages over keys that transmit at 125 KHz, the frequency used in keyless entry systems manufactured by competitors Continental, Hella and Kansei. At 20 KHz, the radio frequency transmissions can more easily penetrate the vehicle’s metal and this means a greater range of operation. It also means that fewer antennas are needed to detect the key’s precise location. “For example, in one of our production applications on a van, the system can detect which door the driver is approaching and open only that door,” noted Mr. Mueller. “Our system can locate the approaching driver and open the proper door at 10 meters vs. two meters for the competitors’ 125 KHz systems.”

According to Marquardt, reaction times for the authorization and unlocking process are considerably faster at 20 KHz than at 125 KHz. Marquardt developed an algorithm that takes measurements simultaneously in three dimensions to quickly and accurately detect the electronic key. Other systems measure each dimension in series, which slows the unlocking process.

Marquardt began development of the system, including the design of its own custom ASIC to operate at 20 KHz, in 1999. It was first launched in 2003.

◆ **Black Panel Switches for the Mercedes S Class**

One of Marquardt’s specialties is being able to offer switches that provide a variety of looks and finishes so carmakers can present interiors that are both fresh and attractive while being functional and safe to operate while driving. Mr. Mueller is particularly proud of the Marquardt black panel surfaces used on many of the mechanical switches in the Mercedes S Class. Each switch presents a clean black-panel foil surface with illuminated symbols to indicate the switch’s function. The micro-switch behind each panel is also produced in house by Marquardt.

◆ **Key with Display and Remote Control**

Another example of Marquardt’s mechatronics capability is a new electronic key with display and remote control, the first of its kind in series production for the commercial truck market, according to the company. Built for the Actros from Daimler Trucks, the optional key can be used to perform certain functions to ease the driver’s workload such as raising the trailer door, checking tire pressure, axle loads and fill levels, or activating convenience functions such as an auxiliary heater, air conditioner or radio from a distance of up to 100 meters. The product was launched in 2011.

**Future Products**

◆ **New Keyless Driver Authorization System**

In mid-2012 Marquardt will launch an updated version of its principal product—driver authorization systems—with a major German carmaker. The system, consisting of antennas, electronic steering column lock and ECU, will be faster, less expensive, and more secure than Marquardt’s current offering. Like the current version, this new system will also require fewer antennas compared to the competition: three versus five.

Additionally, the new system will employ a near-field communication chip from NXP to implement an optional data exchange feature to connect to compatible mobile phones, tablets or laptops.

“We have tested our new system against others in the market and are confident that this system will be the most theft-proof,” said Dr. Marquardt. “And that will bring down insurance premiums.”

“And, since we are able to make this at a lower cost than in the past, we expect that eventually it will be applied even to
Dr. Marquardt is developing new multifunction driver interface to the next generation iDrive controllers used by BMW, business infotainment controllers and 50% of the Mercedes’ Comand multifunction steering wheel. “Working in three dimensions rather than two will make it easier and less distracting to enter letters or words into the infotainment system; recognition will be less mistake-prone,” said Dr. Marquardt.

The character recognition software will come either from Bosch or from CDN. Marquardt’s first order for its next-generation infotainment driver interface comes from a European carmaker. Shipments to that carmaker are to begin in early 2013. Marquardt made the gestural entertainment interface used in the Mercedes F125 concept vehicle presented at the 2011 Frankfurt Motor Show.

◆ Smartphone Car Key

Marquardt has partnered with and invested in Baimos Technologies GmbH, a small startup company located in Garching, Germany, near Munich. Baimos developed a secure mobile access management system called BlueID. The two companies are jointly developing a driver authorization system called BlueID Drive to enable digital car key functions on mobile devices.

After receiving authorization from a computer center operated by Baimos, the mobile phone can unlock the vehicle and start the engine. Once authorized, the mobile phone can also act as a remote control to turn on the climate control system, open the trunk lid or put down the convertible top. The coded authorization message is sent via Bluetooth to a gateway module that is connected to the vehicle’s CAN bus.

The technology would be a good fit for companies looking to automate car rental and car sharing operations. The driver’s remotely authorized cell phone could not only become the key to the vehicle but it could also lead the customer to his rented vehicle and transmit mileage data and fuel usage for remote billing.

Marquardt, who has been working with Baimos for five years, has been hired by three companies to develop demonstrator cars. Baimos lists Daimler as one of its major customers. For more on Baimos’ access management system, please visit www.blueid.de.

Partnerships and Acquisitions

Dr. Marquardt is not at all opposed to forging technology partnerships with other companies if they enable Marquardt to better serve its customers: “For example, let’s assume a customer wants to have a new interior and asks us to do something together with a tier-one supplier because we are not a large enough company to go it alone. That sort of technical partnership we would consider. We have done things like that in the past, for example we have worked with Hella on behalf of Audi.”

Dr. Marquardt would not rule out consideration of an equity tie up with another company if it truly made financial sense for both parties and was necessary to meet customers’ requirements, but at present he sees no such need. And while not actively seeking out acquisitions, Marquardt would consider taking equity positions in other companies, as it did with Baimos.◆
CEA on U.S. Infotainment and Security Market

The year 2007 was a very good one for mobile electronics in the United States—then came the recession from which the industry has yet to recover. Indeed, the only market that won’t have declined between 2007 and 2012 is the factory-installed infotainment systems market, which will barely have any growth at all, just 0.3% per year.

“The OEM side is garnering a greater share of wholesale [or factory] dollars,” said Steve Koenig, director of industry analysis for the Consumer Electronics Association. Mr. Koenig provided the data for the table (at right) and talked to us about the decline of the mobile electronics aftermarket at the expense of the original equipment market.

In the past, the aftermarket used to be the driver of innovation, but no longer. When it comes to car electronics, Mr. Koenig said, carmakers are now in the driver’s seat.

“Carmakers have accelerated their design cycles and are much more in tune with technology trends. They realize that electronics technology sells cars, and that people want to be connected when they’re in their vehicles, just as they are at work or at home.”

Sales in the aftermarket have been declining, Mr. Koenig noted. Not only have prices dropped—for example the wholesale unit price of a head unit has declined from $95 in 2007 to $79 in 2011—but fewer vehicles can accommodate head units. “You’d have to remove the entire center stack of a Lexus to install an aftermarket head unit,” he said.

USB memory stick to the vehicle’s USB port, drive the car, then transfer the car data to their computer to view the analysis. “It’s a simple idea that can be very effective,” said Mr. Antonioli. “You can potentially save up to 9%. Soon we will offer the application for smartphones.”

Mr. Amici chose three examples of electronics developments about which he is particularly proud.

First was the broader availability of radar-supported advanced driver assistance systems—adaptive cruise control, blind-spot monitoring, forward collision warning and cross path detection—in Chrysler vehicles. The Grand Cherokee, Chrysler 300 and Dodge Charger can now be purchased with these ADAS features.

Second was the 8-speed transmission, supplied byZF, on the just-launched Chrysler 300 and Dodge Charger. It features shift-by-wire, console shifter and a steering-wheel mounted paddle shifter.

“One of the main engineering challenges was making sure that this safety-critical part was properly designed with backup communications and diagnostics,” said Mr. Amici.

“We are also proud of the new Magic Parking part was properly designed with backup communications and diagnostics,” said Mr. Amici.

Noteworthy Electronics Developments

I asked Messrs. Amici and Antonioli to tell me about some of the EE developments about which they are most proud.

Mr. Antonioli chose two examples:

One of the main engineering challenges was making sure that this safety-critical part was properly designed with backup communications and diagnostics,” said Mr. Amici.

“We are also proud of the new Magic Parking system available on the Lancia Ypsilon, “which currently holds the record for parallel parking in the smallest space, just 70 centimeters (27.5 inches) longer than the length of the vehicle.” And eco:Drive, a software application that analyzes how you drive, offering suggestions on improving your gas mileage. Users download the application to their computer, connect a

Fiat and Chrysler EE... Continued from page 3