U.S. Fuel Efficiency Gains Unlikely in the Near Term

Carmakers Retreat from Environmental Pledge

Vehicle exhaust emissions, including greenhouse gases such as carbon dioxide (CO₂), increase according to the amount of fuel consumed. Scientists today believe that CO₂ is the main cause of global warming. Light vehicles account for 40% of U.S. oil consumption and produce about 20% of all U.S. CO₂ emissions, according to the U.S. Environmental Protection Agency. Two years ago, the Big Three, led by Ford, tried to create a positive image for themselves as companies that care greatly about the environment. Since then, they have done little to reduce the downward trend in fuel efficiency in new cars and light trucks sold in the United States, and they have aggressively fought against legislation, at both the federal and state levels, that would mandate better fuel efficiency.

Should the U.S. political climate change so that raising CAFE (corporate average fuel economy) becomes possible, or should a future administration address the problem of greenhouse gases, auto electronics suppliers—especially those with advanced powertrain technologies—would benefit from increased demand for those technologies.

Ford, GM and Chrysler have been producing as many big SUVs, vans and pickups as they can sell. Light trucks are their most profitable segment—analysts have estimated Ford’s profit on SUVs like the Expedition and Navigator ranges between $10,000 and $15,000 per vehicle. A result of the growing market for trucks, average fuel economy of the light-vehicle fleet (cars and trucks) has declined to 20.4 mpg in 2001, the lowest point in twenty-one years.

North American Module and System Sourcing—Sluggish

GM’s Strategy Still Murky

Module and system sourcing were hot concepts back in the mid-1990s. Tier-one suppliers liked the idea because it would move them quickly up the value chain, closer to the OEMs. Some tier ones would have more to sell and would see sales and profits improve. On the carmaker side, purchasing managers are usually the main advocates for sourcing modules or vehicle chunks. Some OEMs liked module and system sourcing as a way to significantly reduce the number of in-house engineers and procurement people, and reduce inventory and assembly costs for the parts that comprise a module. Carmakers assumed that module suppliers’ labor costs would be significantly less than automotive union workers. And suppliers, as experts in a narrow product segment, would more quickly advance designs and find production efficiencies unused by carmakers.

While suppliers remain enthusiastic, carmakers today appear to be less compelled by the idea. According to suppliers, North American carmakers, especially General Motors, are more interested in module sourcing than are the Europeans, but even GM’s level of commitment doesn’t seem all that high. Renee Rashid-Merem, a GM purchasing spokesperson, told us, “GM has not adopted an across-the-board module sourcing strategy. Whether it’s done or not depends on the particular vehicle, the plant and the module itself. ... It will be implemented only in places where there are demonstrated efficiencies.”

Ms. Rashid-Merem referred to the unions as key players in any decision to outsource modules. Unions at GM, Ford and DaimlerChrysler have been dead set against modules because they mean outsourcing and fewer jobs for United Auto Workers, although the UAW has been trying to organize more workers at supplier plants. UAW contracts with the Big Three in the States block outsourcing without agreement from the unions. Given the potential for union trouble, both in North America and Europe, GM has set up modular assembly to source systems and modules outside allows the automaker to use technology without investing in it. Better technology might be available from suppliers who specialize.

Outsourcing provides an opportunity to bring technical innovations to market faster. Suppliers can ensure that all the interior trim panel finishes match perfectly. Suppliers say they would be best at making parts that can’t be seen. Module or system sourcing might work best for OEMs that serve small niches in a few regions, e.g., BMW.

By outsourcing key technologies, OEMs could give up too much clout to suppliers and capabilities could migrate from OEMs to suppliers.

It is difficult to objectify the economic advantages of modular or system sourcing. Suppliers will have trouble quoting the total cost of modules and systems, since so much is unknown before the project starts.

If OEMs defer key component sourcing to suppliers, then the number of different component parts could go way up, yielding the opposite effect of making parts common.

The supplier may not have the economies of scale the OEM would have, so component costs could go up.

Purchasing systems and modules unbundled tends to reduce costs for carmakers.

Carmakers are organized around functional systems, not modules.

Pros

- Sourcing systems and modules outside allows the automaker to use technology without investing in it. Better technology might be available from suppliers who specialize.
- Outsourcing provides an opportunity to bring technical innovations to market faster.
- Suppliers can ensure that all the interior trim panel finishes match perfectly.
- Suppliers say they would be best at making common all the parts that can’t be seen.
- Module or system sourcing might work best for OEMs that serve small niches in a few regions, e.g., BMW.

Cons

- Finger-pointing: when something doesn’t work, who’s at fault?
- Unions see modules as another word for outsourcing; they stand in opposition.
- By outsourcing key technologies, OEMs could give up too much clout to suppliers and capabilities could migrate from OEMs to suppliers.
- It is difficult to objectify the economic advantages of modular or system sourcing. Suppliers will have trouble quoting the total cost of modules and systems, since so much is unknown before the project starts.
- If OEMs defer key component sourcing to suppliers, then the number of different component parts could go way up, yielding the opposite effect of making parts common.
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- Purchasing systems and modules unbundled tends to reduce costs for carmakers.
- Carmakers are organized around functional systems, not modules.
U.S. carmakers now seem to be backing away from their environmental chest-thumping and their promises that they would voluntarily improve SUV mileage 25% by 2005. (A 25% increase would bring SUV’s up to 20.1 mpg, slightly worse than the current 20.7 mpg CA FE requirement for light trucks.) This month, Ford spokesman Kristin Kinley told us that Ford is still sticking to its pledge, although, “economic conditions might make it more difficult to achieve.” But in a current TV ad campaign promoting large, muscular, Ford “light” trucks, chairman and CEO William Clay Ford says, “Ford is now hanging its hat on power.” It appears Mr. Ford has hung his environmentalist hat back in the closet.

GM spokesman David Barthmuss told us that GM vice chairman Harry Pearce, the man who made GM’s promise to best Ford in fuel economy in 2005, is no longer with GM. Mr. Barthmuss added, “GM is focused on the long term, especially on fuel cells, which would make all this talk about gasoline and diesel efficiency moot.”

Chrysler too is betting on fuel cells as a long-term solution to mitigating the effects of light vehicles on global climate change. Also backing the fuel-cell solution is the U.S. Department of Energy, which announced it will fund fuel-cell research, but it will cease funding research aimed at hybrid or electric vehicles.

No Federal Mandates Near Term

Other than CA FE, enacted in 1975, no further mandates that would restrict greenhouse gas emissions and improve fuel economy have been issued by the U.S. government. The U.S. Congress, which has been lobbied heavily by the oil industry, carmakers, the United Auto Workers union and farmers, has kept CA FE standards for cars frozen at 27.5 mpg since 1986; the light truck standard is reviewed annually, but has remained at 20.7 mpg since 1996.

Recently the U.S. Senate soundly defeated an amendment sponsored by Senators Kerry and Hollings to the Energy Policy Act of 2002 that would have raised CA FE to 36 mpg by 2015. Instead, the Senate passed an amendment that instructs NHTSA to come up with proposed rulemaking, which could lead to modestly higher fuel efficiency standards for light trucks years in the future. The truck standard will stay frozen at least through the 2004 model year.

California and Other States Could Raise Fuel Efficiency Standards

In July, the governor of California signed a bill that instructs the California Air Resources Board to produce by 2005 regulations that “achieve the maximum feasible reduction in greenhouse gases.” The state assembly has until 2006 to review the law and make changes. Assuming the mandate stays intact, it will apply to new vehicles no earlier than the 2009 model year. The Alliance of Automobile Manufacturers fought hard against the California emissions law, saying that the law effectively sets state fuel-economy standards. The Alliance, which includes every carmaker that sells vehicles in California with the exception of Honda, is likely to challenge the bill as unconstitutional.

On the heels of the California legislation, eleven state attorneys general representing the six New England states, Maryland, New York, New Jersey, Alaska and California warned President Bush that if the federal government doesn’t take action to slow the growth of greenhouse gases, the ten other states may adopt California’s law. The California mandate gives hope to environmentalists, but time seems to be on the side of the carmakers.

Market Forces

While low fuel prices have prolonged Americans’ affinity for SUVs, global pressure to reduce greenhouse gases has been slowly building over the last decade. That pressure will continue upward until eventually, maybe a decade from today, and probably only if government mandates force the issue, U.S. automakers will come to their senses and begin to significantly improve the fuel efficiency of their new vehicles. They will have to, if they are going to compete on a level playing field with the Japanese and other carmakers who are leaders in fuel-efficient powertrains. The Big Three have been steadily losing market share to the Japanese and others for the last decade. At the end of May 2002, Detroit carmakers held 61.8% of the U.S. vehicle market, according to the Detroit News; that’s a 12-point drop since 1993. As the environmental movement grows and today’s environmentally-savvy youth become car buyers, more customers will avoid Big Three vehicles in favor of Honda, Toyota and others who have already built solid reputations for making reliable, fuel-efficient vehicles.

As the demand for fuel-efficient vehicles grows, the demand for powertrain control technology will also grow, and that will be a boon to suppliers of electronic engine and transmission controls and components. Currently available fuel-saving technologies include: electronic throttle controls, cylinder deactivation, mechanically-controlled variable valve timing, electric power steering and six-speed automatic transmissions. As work on more advanced technologies yields cost reductions and improvements, demand for the following technologies will blossom: hybrid powertrains, electromechanical valve timing, integrated starter alternators, start-stop, boost and regenerative braking, beltless engines, direct injection, clutch-to-clutch automatically controlled manual transmissions, and continuously variable transmissions on large vehicles. The potential market for new products like these is huge. ◆
projects in South America, China and other places where unions are less organized.

Another factor that complicates the decision to go outside for modules or systems is the lack of accurate accounting numbers that objectively prove which solution is best. Ben Baker, director of GM’s electrical engineering center told us: “Some at GM would have us go outside for the entire safety system—airbags, sensors, seatbelts and pretensioners, plus calibration, certification and dealing with governments and lawyers. How does the supplier quote that? How many man-years will be needed? What contingencies are set aside for lawsuits?”

**What’s Core Should Stay In House**

Before implementing a module or system-sourcing strategy, carmakers must first decide which development and production capabilities need to be kept in house and which can be outsourced. Core competencies are those things that help distinguish one car from another in terms of features, quality or price and serve to attract more customers. For example, GM would probably consider the integration of radio head units into the vehicle’s interior as a core competence that should stay in house. That way, GM is better positioned to keep radio part numbers at a minimum and the quantity of radio units at a maximum, which lowers total radio procurement costs and helps the carmaker maintain clout with suppliers.

Ben Baker thinks it’s wise to outsource those modules or systems that car owners don’t see, touch or feel, for example, back-up safety systems or the structural parts that support seats. But he and the rest of the automotive electronics community at GM think it’s wrong to throw away scores of man-years of accumulated experience by handing over responsibility for electronics and electrical parts to suppliers of interior modules. Interior suppliers would have a much harder time integrating electronics into modules than would GM.

“We like to integrate and aggregate systems ourselves,” declared M.R. Baker, “so we can be aware of opportunities to integrate additional functions, features and systems. Whoever does the integration work must know the vehicle very well.”

**Integrated Interior Systems**

Johnson Controls Inc., which has been promoting interior module subassemblies for years, believes that its first completely integrated interior system, including all the interior modules, plus the electrical and electronics systems and components located in the interior, will ship to a carmaker by 2008 or so. “The trend to systems and module sourcing is generally headed up,” said Jim Geschke, vice president, electronics integration at JCI, “but the pendulum swings back and forth. At times carmakers are accelerating; at other times they are backing off. Some carmakers don’t care about modules at all.” Mr. Geschke expects both interior modules and interior systems to get physically larger and more complex, culminating with the integrated interior system.

**More Extreme Competition**

Should the market expand, the competition among suppliers to win production contracts for modules and systems could be intense. Interior module suppliers like JCI, Magna and Lear will battle system suppliers such as Motorola Automotive Communications and Electronic Systems (ACES) for top-tier status with carmakers. Motorola has developed strategies that put it into direct competition with some of the module makers. Jacqui Dedo, Motorola ACES vice president and general manager, worldwide market operations, told us that Motorola is now keen to take on bigger pieces of the vehicle, for example, interior systems with multimedia, as well as chassis and powertrain systems.

**Siemens VDO Automotive** is taking a somewhat different tack. Siemens VDO would work either as an equal partner with a traditional interior module supplier, perhaps in a joint venture, or as a top-tier supplier itself. “Three parties have to be involved,” said Walter Maisel, Siemens VDO vice president in charge of the interior and infotainment business unit. “One party is the OEM, who has to be involved because interior modules must conform to the designer’s look, feel and corporate identity. The second party is the module supplier, like JCI. They provide the plastic cockpit. The third part is the electronics industry. It takes all three to make it happen.”

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**Possible Modules and Systems**

**Modules:** Vehicle subassemblies of co-located parts that could be delivered to the carmaker.

**Cockpits systems, which could include:**
- Instrument panels
- Trim
- Structural duct
- Climate control
- Steering column
- Pedals
- Airbags
- Clusters
- Multimedia entertainment systems
- Information terminals
- Junction boxes
- Wire harnesses

**Integrated cooling modules**
- Air cooling radiators
- Air conditioning condensers

**Corner modules**
- Brake
- Suspension

**Interiors**
- Instrument panels with electronics
- Seat systems
- Overhead modules
- Headliners
- Door modules
- Instrument panels
- Rolling chassis (wheels, brakes and suspension system mounted on the frame)

**Systems:** Combinations of related elements that function together as a unit.

- Audio
- Electrical distribution (wiring)
- Electrical architecture
- Distributed processing
- Network computing
- Lighting systems
- Exterior
- Interior
- Safety systems
- Brake systems

The automotive industry is at a point where it is waiting to see how some of its initial module- and systems-sourcing projects work in practice. Ford recently sourced a fourth complete brake system to Continental Teves. The brake system, which includes ABS, brake assist, electronic brake force distribution, traction control and ESP (electronic stability program) technology, will come from Continental Teves plants in the U.S. and Mexico. Siemens VDO supplies a complete cockpit module for the Smart in Europe. If it can be objectively proven that outsourcing really does significantly save money without erasing customer-winning competitive distinctions, and if the unions cooperate, carmakers will tackle many more such projects. 

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The Company Profile... Elmos Semiconductor

**Background**

**ELMOS** was established in 1984 in Dortmund, Germany, to make customer specific integrated circuits for the automotive industry using its unique high-voltage CMOS processes. Today, the company designs, prototypes, manufactures, tests and assembles customer specific integrated circuits in house. Eighty-five percent of shipments end up in automotive applications. Device voltages range from six to 42 volts, although today most are powered by 12 volts. The trend in the auto industry is to combine as many components as possible in a single assembly, moving from printed circuit board to multichip solutions and then to single-chip solutions. The company makes wafers as big as six inches and can make chips with feature sizes down to .5µm. ELMOS can wafer probe and do mixed-signal testing. The company maintains analog and digital cell libraries, as well as its own process technology libraries.

ELMOS has been profitable since 1990. In 1987, BMW became involved as a shareholder and sales took off. BMW in 1996 represented as much as 40% of sales and is still the top-end user, responsible for 24% of total sales. At the end of 1998, BMW sold its stake in ELMOS to the founders of ELMOS. A new IPO was completed in 1999 and ELMOS is now listed on the Frankfurt Stock Exchange in the “Neuer Markt” segment (ELG:FSE).

**ELMOS Sales and Net Margin in € Millions ($ Millions)**

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<th>Year</th>
<th>1997</th>
<th>1998</th>
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<td>Sales</td>
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<td>Net Profit Margin</td>
<td>2.0%</td>
<td>0.5%</td>
<td>11.0%</td>
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**Net Profit Margin**

- 1997: 2.0%
- 1998: 0.5%
- 1999: 11.0%
- 2000: 15.7%
- 2001: 10.8%

Note: ELMOS estimates up to 5% growth in sales in 2002, and a 20% increase in 2003. Using 1999 as a basis for comparison, ELMOS sales have since grown 11.2% annually, while the worldwide semiconductor market declined 3.7% annually.

The company has worldwide design capabilities, with design and/or sales teams of seven to 21 people in Frankfurt and Munich, Germany, as well as in Detroit, Michigan, and Paris, France. In 2001, ELMOS acquired two companies that gave it the ability to produce fully integrated smart sensor systems: SMI (Silicon Microstructures Inc.), Fremont, California, a developer of automotive sensors with high-volume production capability; and Eurasem (European Semiconductor Assembly B.V.), located in Nijmegen, Netherlands, a developer and assembler of both custom and standard packages, also with high-volume production capability.

ELMOS intends to continue to focus on customer specific solutions in the automotive areas of comfort electronics, safety electronics and motor management, as well as instrumentation and bus-link ICs. The goal is to be a leader in mixed-signal ASICs, designing system solutions using standard micros surrounded by ELMOS ASICs. An alliance with Mottorola in 2001 not only gives ELMOS access to Mottorola micros and development tools, but the two companies plan future developments of system-on-chip solutions for the automotive industry.

In 1999, the company brought in 19 design wins that resulted in about €125 million ($121.5 million) in new sales over the life of the contracts. In 2000, ELMOS booked 24 new orders, and 27 in 2001 or sales gains of an additional €220 million ($213.8 million) starting at the end of 2003. ELMOS hopes to win about 30 orders in 2002 and about 35 in 2003. It takes between two and three years from design win through qualification to volume production; with production lasting about five years, on average, and sometimes over 10 years.

“Some important customers are Valeo, Siemens VDO, Kostal (comfort), Autoliv (safety), Pierburg (engine management application) and Borg (instrumentation),” suggested Peter Thoma, ELMOS board member and managing director in charge of marketing, sales and engineering. “It’s hard to get business with Bosch because of its own process capabilities, and Magneti Marelli is in close relationship with STMicroelectronics. Siemens still has some relationship to Infineon.”

In Europe and the United States, the company’s strongest competitor is STMicroelectronics. Siemens explained ELMOS sales manager Frank Stratmann, adding that in Europe, Mélalex (Belgium) is also strong.
But M elexis, which is almost the same size as ELM OS, is focused on sensor applications and prefers application specific standard solutions.

**Strategy**

ELM OS is strong in interface elements, input and output devices, body controllers, engine management, safety systems and comfort electronics. ELM OS products tend not to be used in tuners, radios or entertainment systems. The needs of ELM OS' largest end-user, BMW, have helped shape ELM OS' product line, its capabilities, processes and system know-how.

ELM OS believes it and other small suppliers have advantages over large semiconductor suppliers. While larger companies must produce in high volume to fill their fabs, companies with sales of €500 million ($486 million) or less, are far more flexible in designing and producing customized application specific products in volumes starting at around 100,000 per year. “Flexibility means we develop solutions and prototypes quickly ... we are not just asking for specs but working together with the customer on a system level,” noted Erhard Müsch, vice president, product development. While flexibility is an important competitive advantage for ELM OS, according to Dr. Thoma, ELM OS' systems knowledge and emphasis on automotive quality are also very important. “ELM OS engineers are partners, and we have the experience and know-how in automotive systems to really support our customers.” The company has 16 years of experience in automotive systems design. Before ELM OS, Dr. Thoma was BMW's top electrical engineering manager and remains a respected voice in the global automotive electronics industry.

ELM OS' biggest competitor, ST Microelectronics, is large enough that it would prefer to start with orders of two million parts per year, according to Dr. Thoma. “We cannot compete against the big producers of highly integrated micros, because we do not have the power of marketing that they have, nor do we have the applications help, nor the build-up in tool sets, but [we perform well] in customer specific applications. ST Microelectronics has even said to us, 'You are better in systems design than we are.'” For example, one product that ELM OS was able to do because of the direct interaction between design, technology and fabrication was an express window system that uses a ripple voltage counter to stop the window if an elbow or finger is about to be squeezed. The part is used by BMW.

A nother example of ELM OS' flexibility is that it took the advantage over larger companies when it won orders from BMW and Mercedes to supply stepper-motor drivers. The A/C system, which employs up to 15 stepper motors, had been using a total of 60 wires, four for each motor. The new system will employ a 3-wire bus that links all the motors to the control system. For multiplexing in body systems applications, BMW started with K-Bus, which is basic for the future standard LIN protocol. ELM OS has been BMW's only supplier for the K-Bus, supplying about six million units per year.

**Technology**

In the future, as mechatronics replaces small PC boards, ELM OS expects that its technology will yield smaller, cheaper auto products. A source of technology has been ELM OS' association with Professor Günther Zimmer, who is one of the founders of ELM OS and chairman of its supervisory board. Professor Zimmer is also director of the Fraunhofer Institute for Microelectronics Circuits and Systems. The German research institute, located in Dresden, Duisburg and Munich, has been responsible for much of ELM OS' basic research; the company still has some research projects with Professor Zimmer. A nother source of technology is nearby University of Dortmund, where many ELM OS engineers have studied.

ELM OS' first step into automotive was based on a 14-volt CMOS (complementary metal oxide semiconductor) process, which was developed by Professor Zimmer especially for mixed-mode applications. The process allows mixed-signal devices to be implemented with automotive voltages, directly connected to the battery. ELM OS' embedded core systems can employ standard microprocessors, while making CMOS peripherals on the same chip that handles high voltages. ELM OS' high-voltage CMOS technology can make continued on following page
modules that are capable of up to 100 volts breakdown, and up to 10 amps of current.

SOI
A another technology proprietary to ELMOS is its SOI (silicon-on-insulator) based process, which has shown great promise for high temperature automotive applications. To visualize an SOI circuit, picture the cross-section of a cube, where the bottom part is taken up by a silicon based material. Various semiconductor components are attached atop the silicon base: digital and analog devices as well as diodes and DMOS devices. The devices are insulated from each other by trenches, and from the silicon base by a layer of buried oxide.

Because of the absence of leakage currents, SOI technology gives digital and analog semiconductors the ability to handle more power, and since SOI is capable of high-temperature performance, SOI devices are more stable, with less crosstalk and less bulk current. Devices based on the technology are 34% more expensive but are 30% more capable than devices that use standard bulk silicon. ELMOS is working on SOI devices with .8µm feature sizes. Volume production of SOI parts with feature sizes of 1.2µm began in 2001. The devices were used as a V A N bus I C interface (125 kbits/second). ELMOS also used an SOI device for a single-chip alternator regulator IC, which combines a RISC C PU, analog circuits and an 8-amp driver on one chip. The device can work at a junction temperature as high as 175 degrees C.

Mr. Müsch noted that even higher temperature SOI applications are on the way: “We are working on some design structures to get into higher temperatures, especially the packaging features. Today, most semiconductor companies specify maximum junction temperatures at 150 degrees C. Realistically, 175 degrees C is a short-term temperature goal for ELMOS, with 200 degrees C as a long-term goal.” Applications include power steering, braking and engine management.

Aquisitions and an Alliance
◆ Eurasem: In 2001, ELMOS acquired European Semiconductor A ssembly B.V., a high-volume developer and assembler of high quality custom and standard semiconductor packages, located in Nijmegen, the Netherlands. Eurasem’s patented moulding technique, applicable for plastic packaging, is used for M E M S (microelectronic and mechanical system) sensors. M STs (microstructure technologies), image sensors, pressure sensors and gas/fluid sensors. ELMOS, with its own A Si C’s and with Eurasem’s packaging and assembly, can now build intelligent systems. ELMOS will transfer some volume assembly from its Far East assembly subcontractors to Eurasem.

◆ SMI: In 2001, ELMOS also acquired Silicon Microstructures Inc. (Fremont, California), a developer of sensor technology for automotive and other markets with high-volume production capability. SMI is considered a technology leader in the area of high precision silicon-based pressure sensors; the company’s founders were pioneers in the micromechanical sensor business. SMI sensors are already used in automotive applications like fuel-tank leakage monitoring, as well as in brake and engine control systems. ELMOS can offer just a sensor element or the company can make a fully integrated smart sensor system, including sensor elements and electronics, packaged by Eurasem. SMI will develop new sensors, based on its M E M S sensor technology combined with ELMOS’ mixed-signal smart power CMOS capabilities.

◆ Motorola: In 2001, Motorola and ELMOS set up an alliance in which the companies will share technology and develop and produce improved automotive semiconductor solutions. One of the main outcomes of the partnership is that ELMOS will be able to make on-chip system solutions using its own high-voltage CMOS processes. These peripherals will be arranged around a Motorola H C 12 or Star 12 microprocessor core. Devices based around Motorola’s 8-bit micros will provide affordable solutions, for example, a remote keyless entry controller. Combining embedded Flash or EEPROM with on-board networking, the 16-bit H C 12 product line will be used for medium-speed network applications such as doors, seats, window lifts, HVAC, sunroofs and lighting. Combining microcontroller and DSP functions will in time yield new electric power steering, cruise control and drive-by-wire products.

ELMOS will use Motorola’s development tools and has signed a license to transfer Star 12 cores from Motorola, the world’s leading supplier of semiconductors to the automotive industry. ELMOS will also integrate Motorola’s Flash memory modules into its high-voltage CMOS processes. ELMOS can also access Motorola’s H C 12 cell and design-method library of complex logic circuit blocks. One of the first ELMOS products to come from the alliance will be a new 5µm product based on Motorola’s 16-bit H C 12 family of microprocessors. Development will probably take one year. Production could begin by mid-2003.

New Products
42-Volt Projects: Although Daimler-Chrysler announced that it has slowed its introduction of 42 volts into the S class, Mr. M üsch predicted, “Everyone knows that 42 volts will come eventually; in my opinion, we’ll [first] see it in 2005, in volume, maybe from the French or the Japanese.” Electric valve controls, A/C compressors, electric steering and electric brakes are driving carmakers to adopt
**The Company Profile Continued**

42-volt power generating and storage systems.

**CMOS Chip Camera:** Currently in prototype, cameras could be used to visually monitor oncoming objects so that airbags could be ignited earlier in the event of a crash. First samples of the product in low volumes will be priced at about five euros ($5) each. The recent acquisition of Eurasem, a provider of special packaging, will prove useful in the assembly of this product.

**HALIOS (High Ambient Light Independent Optical System):** This technology is based on a group of 24 optical sensor patents from a German invention team and will potentially yield applications ranging from rain sensors on vehicle windshields to keyboards in mobile handsets. ELMOS has an exclusive global license to HALIOS, although its first application, a rain sensor for a French top-tier supplier to French carmakers, will remain proprietary to the French supplier. The spec is defined by a software algorithm. HALIOS detects presence, three-dimensional motion and speed. Moreover, HALIOS optical sensors are not influenced by ambient light, can detect motion up to one meter, suppress the effects of dust, scratches and temperature, plus they are self-calibrating and self-adjusting. Prototype ASICs are already available. In addition to rain sensors, applications include motion control and finger “roll point” control on mobile navigation units and other mouse-like controls.

**Integrated Alternator Regulator Controller:** Dr. Thoma told us, “Regarding new technology that will impact sales, the integrated alternator controller using SOI technology is the most advanced product we have; we are doing it for Valeo.” According to the 2001 annual report, the product will develop into a family of products since SOI regulator features cannot be achieved by conventional technology.

**Multichip Solutions:** ELMOS’ highest-volume product is chips used in airbag applications. The chipsets have a minimum of five and a maximum of seven chips, which surround a third-party micro. ELMOS develops and produces chipsets for A SL-Takata in the United States, for Autoliv, and since this year, for Conti Temic.

**Park-Distance Controller:** ELMOS told us that this third-generation ultrasonic park-assist circuit is one of the most important development projects in terms of future sales. The park-distance device is smaller, the result of integration and the elimination of the printed circuit board. The circuit is less susceptible to electromagnetic interference—the result of shorter interconnections within the device—and most importantly, it costs less than its predecessor. The new device replaces past park-assist devices that used on-chip trimming, done by laser before the device was encapsulated into its packaging. That process was expensive and caused variations in the electrical parameters, resulting in low yields. In the company’s new device, the chip remains untrimmed until after packaging. Conversion into analog values occurs after packaging; trimming can be done via the data interface after assembly.

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**2000 European Automotive Semiconductor Market**

- TI, 2%
- AMD, 2%
- Toshiba, 2%
- Intersil, 2%
- ELMOS, 2%
- Fujitsu, 3%
- NEC, 3%
- Intel, 4%
- Philips, 6%
- Bosch, 9%
- STM, 9%
- Motorola, 10%
- Infineon, 12%
- Denso, 1%
- ATML, 1%
- Others, 31%

Data: Gartner Dataquest via ELMOS

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**ELMOS Automotive Applications and Products Currently in Production**

**Comfort and Body Electronics**
- Analog and digital clocks
- Centralized door locking
- Cruise control ICs
- Heating and air conditioning systems (intelligent stepper-motor driver with stall detection for climate system actuators)
- Internal lighting/dimmers
- Instrument meter drivers
- Park distance controls
- Power window controls (express down, express up with pinch protection and ripple counter for position sensing)
- Remote keyless entry devices
- Ripple counters (for seat memory)
- Seat heating
- Wiper controls (front and rear)

**Motor Management**
- Airflow measurement

**Safety Electronics**
- Airbag ICs (including monitoring ICs)
- Anti-theft system ICs
- Intelligent power management ICs
- Seat occupancy recognition (child and passenger) ICs
- Transponder key ICs
- Xenon headlight driver ICs

**Miscellaneous**
- Byteflight ICs
- K-, LIN-, VAN-bus ICs
- Other bus ICs

**Multichip Solutions:**
- Bus ICs with integrated voltage regulators
- Hall ICs
- Interface ICs
- Input ICs
- Lamp control modules
- Output drivers
- Power MOS drivers
- Switch regulators
- CAN transceivers
- Watchdog ICs

**ELMOS**
We have attended every Convergence since The Hansen Report was founded in 1988, and we have never been disappointed. We enthusiastically support Convergence because it gives attendees the chance to hear from and talk to key people from carmakers and suppliers worldwide. The exhibit floor, two receptions, the banquet finale and technical paper presentations provide ample opportunities to connect with CEOs, directors, engineers and managers, all of whom have a stake in automotive electronics. Conference chair Denise (Denny) Freitag, DaimlerChrysler, the only full-time Convergence employee, organizes and implements each Convergence conference, a monumental feat she accomplishes with the help of many industry volunteers.

This year 50 papers will be delivered. Each paper session has been put together by a top executive from a carmaker or supplier. To reflect the 2002 conference theme, “Automotive Electronics, the Process, the Technology and the Business,” the sessions have been organized into those three topic areas — process, technology and business. Ms. Freitag elaborated: “It takes more than gee-whiz technology to make electronics and software work in cars. You also need to be in control of the processes and make certain that you have a good business plan. If a business case can’t be made, then what’s the point?”

Despite economic troubles in the industry due to declining car sales in some markets, we expect that Convergence 2002 will be just as successful as the record-setting Convergence 2000. So far, 140 exhibitors have signed up. Convergence 2000 drew 170 exhibitors, but given that 11 weeks still remain before Convergence 2002 begins, that number should be attainable this year as well. AII 18 sponsorships have been sold, and the number of attendees is likely to equal or surpass the record 9,000 who came to Convergence 2000.

Panel discussions are an excellent way to produce solid new information about our industry, and Convergence 2002 has planned three plenary panel sessions. J. T. Battenberg III, chairman, CEO and president of Delphi, will moderate the Blue Ribbon Panel on Monday morning, October 21. The panel’s theme is the future of transportation electronics. Panelists include Norio Omo, senior managing director, board of directors, Denso; Marios Zenios, senior vice president, Mototora; Gerhard Schmidt, vice president, re- search, Ford Motor Company; Hironobu Ono, director, member of the board, Toyota; and Larry Burns, vice president, research and technology and North American planning, General Motors.

On Tuesday, Paul Hansen will convene and moderate a luncheon panel comprising top electrical engineers from six major carmakers: Heinz-Georg Burghoff, director E/E, DaimlerChrysler; Hans-Georg Frischkorn, director E/E, BMW AG; Toyohei Nakajima, division director, Honda R&D Americas; Matt Tsien, executive director electrical, General Motors; and Cary Wilson, director of E/E systems engineering, Ford Motor Company. All the panelists are key decision-makers who help define the electronic, electrical and software systems and components in future vehicles. The panelists will be asked questions about their challenges and opportunities, how suppliers can help, the status of various standards and which E/E products and trends are the hottest.

The third plenary panel discussion, Convergence and Its Business Implications, takes place on Wednesday afternoon. Dr. C. K. Prahalad, the Harvey C. Fruehauf Professor of Corporate Strategy, University of Michigan Business School, will be the moderator.