Electronics at Ford North America: Signs of Life

Not all is doom and gloom for suppliers intent on playing a role in Ford North America's electrical and electronics parts supply chain, although as the carmaker loses share in North America it is becoming a significantly smaller customer. Just how much Ford has lost already was objectified by its decision announced on January 23 to reduce its North American vehicle making capacity from 4.55 million units to about 3.35 million by 2008.

Ford said it would cut 10% of its white collar workers, but after the smoke cleared on “Black Monday” when people were let go or forced to retire early, the impact on Ford’s North American Electrical and Electronics Systems Engineering (EESE) group was substantially less than on other organizations. “We hired heavily during the past year, and we were able to retain those new critical skills,” explained Graydon Reitz, who runs EESE. Roughly 700 electrical engineers work for Mr. Reitz, according to our own estimate.

Research and Advanced Engineering’s electronics group also survived relatively unscathed: only two or three out of approximately a dozen engineers were cut or transferred out to other activities. Safety systems product development and research lost about eight out of approximately 70 engineers.

The number of engineers doing electronics research at Ford North America has been dwindling for years. In 1999 under Ford Research head Bill Powers, there were two activities with a total of roughly 70 engineers doing electronics related research at Ford, one working on software and the other working on systems. Today Ford Research and A dvanced Engineering is focused on powertrain development, especially on hybrids and diesel engines.

Turn to Ford, page 2

Automotive HDDs: Not So Hot

Hard disk drive makers Toshiba and Seagate have been promoting the notion that the market for automotive hard disk drives is very hot and about to break out well beyond the shores of Japan, where it got its start as a nonvolatile storage media for navigation data and more recently for digital music files. According to automotive hard disk drive pioneer Toshiba, citing market data from IDC, 2.4 million automotive HDDs were sold in 2005 and by 2009 sales will climb to 8.5 million units.

But that forecast might be overly optimistic. For one thing, it doesn't account for Flash drives, which will take a big bite out of the market for automotive HDDs. “Flash drives are a serious contender to hard drives,” said K. Venkatesh Prasad, who is responsible for infotronics at Ford’s Research and Advanced Engineering Group. “If you look at the cost benefits of something mechanical that’s moving, subject to degradation vs. something that’s static: I would place my bets on things that don’t move.” A Flash drive typically consists of one to eight NAND memory components plus a small controller chip.

Don Barnetson, associate director of Flash marketing for Samsung Semiconductor, which has been promoting the use of Flash drives to carmakers, makes a case for Flash: “Flash costs $35 per gigabyte today compared to less than a dollar per gigabyte for a hard disk drive. However, over the last 10 years, Flash pricing has fallen about 40% per year. The basic price of the HDD doesn’t fall but you get more bits for the same price. If that HDD costs $50 last year, it still costs $50 this year but you might get 50% more bits.”

“If I’m designing a head unit today, it won’t launch until 2009, and it must ship until 2014. Even though by 2014 the hard drive will have maybe 10-times or 20-times more bits [of storage capacity], the application doesn’t change, so I can’t rely use all of those bits,” said Mr. Barnetson. Today a 20 GB Flash drive is quite expensive but with prices declining at 40% per year, in five years the price will be $50; the same as a hard drive today. For 40 gigabytes of Flash, cost parity would take 6.5 years.

Mr. Barnetson also pointed out that Flash performance is much faster than HDDs, and Flash has a history of proven reliability in the automotive environment, having been used in engine control units for the past ten years.

For some carmakers a 40 GB drive is overkill. For many applications, less memory will suffice. “Today you can buy and 4 GB SD (Secure Digital) card, which is enough for about 1,000 songs,” noted Mr. Barnetson. Personal navigation device maker TomTom sells a unit in the aftermarket with a 1 GB SD card sufficient to navigate throughout the United States.

However, some carmakers definitely will want the large storage capacity that HDDs provide. “If you want a music collection and high quality 3D navigation with 10 million points of interest ... if you want to have games for the kids, a couple of audio books and a collection of videos, you can get past 40 gigabytes in about two seconds,” asserted Amy Dalphy, manager of audio and video applications for Toshiba. Other applications for HDDs or Flash memory include recording digital radio programs for playback later, and some years from now, diagnostic data storage.

Toshiba recently said it can now sample to automotive customers 2.5-inch, 40 GB HDDs which are capable of operating over temperatures ranging from -30 to +85 degrees C. Toshiba, which claims to have an 85% share of the market, pioneered automotive HDDs in Japan, where the vast majority of them are sold. In Japan HDDs were first sold in aftermarket applications; factory installation by carmakers started in 2005.

Turn to HDDs, page 2
**HDDs**

A long with the Flash alternative, digital rights issues will slow the rate of HDD adoption. Carmakers and infotainment suppliers don’t want to develop products that make it easy to produce illegal copies.

Seagate, the world’s number-one hard disk drive manufacturer with 30% share of the overall market, doesn’t yet produce HDDs for automotive applications but very much wants to. Dave Anderson, director of strategic planning for security products at Seagate, has been looking into automotive requirements. “The content that could be put on a hard drive has to be protected in the sense that the system manufacturer or automotive manufacturer will need to be able to prove that he is not providing a vehicle for copyright infringement. ... They don’t want to be sued,” said Mr. Anderson. “One threat is the unscrupulous dealer who could order a car loaded with entertainment and navigation content, pull the drive out, copy it to a PC and then copy the contents to a bunch of drives for other cars.”

Seagate has been developing security functions that could be installed on an HDD and working with groups within the International Standards Organization to make the security features standard. HDD makers Hitachi, Fujitsu and Samsung have joined Seagate’s standards-making effort but, unfortunately, Toshiba has not. Other different standards from Apple, from Microsoft and from others are also in play, which will make it difficult to settle on one.

Coming up with a solution to the digital rights management issues is particularly difficult for automakers. “In the automobile you’ll have to handle music from many different sources, videos from different studios, navigation content and diagnostics data,” said Mr. Anderson. “Each of these requires different security methods.” A solution that protects all parties will take years to develop.

**Ford...**

Good news for electronics suppliers looking for new projects: Ford’s “Back to Basics” mantra is being replaced by a more aggressive stance with new products. “We will see substantially more technology and innovation in a quicker time frame than what we had before in North America,” declared Mr. Reitz.

For example, Ford is working on new safety features (ironic given the loss of some safety engineers in research) as well as a connectivity module that will make it easier for customers to bring portable electronic devices into the vehicle. Engineers are developing a module consisting of a USB connector, a wireless Bluetooth connector and an iPod connector for introduction in a 2008 model year vehicle, or possibly sooner. The project will rely heavily on Microsoft and will use the Windows Mobile operating system.

The connectivity module hardware will likely be supplied by experienced telematics suppliers Nokia and/or Motorola. Nokia currently supplies Bluetooth connectivity to Ford of Europe.

In the near term, Ford North America will make a concerted effort to quickly transfer some electronics features developed by Volvo and by Jaguar to North America vehicles. A clive safety features are visible and easily understood by customers and would help to differentiate Ford vehicles. Some of the active safety products most likely to be transferred include a lane-keeping system, radar adaptive cruise control integrated with a vision-based system, and an intersection crash mitigation system.

A hopeful development well-received by Ford electrical engineers is the elevation this fall of Derrick Kuzak to vice president of product development, the Americas. Ten years ago, when he ran Ford’s Electrical and Electronics Systems Engineering group, Mr. Kuzak talked about the importance of implementing electronics the same way throughout Ford’s global operations as a way to save millions of dollars worth of redundant engineering effort. “That is one of the key things Derrick is [now] bringing to the organization,” noted current EESE manager, Graydon Reitz. “We are going to a global electrical architecture that will allow seamless transition of features from Europe to North America.”

Still, electronics engineering is heavily compartmentalized, with separate organizations at each of Ford’s car divisions: Volvo, Jaguar, Ford of Europe, Mazda and Ford North America. Travel budgets had been curtailed in the previous round of cost cutting, which made cooperative, collaborative relationships among engineers difficult to maintain. Recently, however, a team of Ford North America EESE engineers spent a week with their counterparts at Volvo in Sweden.

Mr. Kuzak, an electrical engineer with a doctorate in systems engineering, is responsible for all aspects of the product development system. He reports to Anne Stevens, Ford executive vice president and chief operating officer, the Americas. Electronics engineering managers at Ford can now be confident that top management at Ford will understand what they are talking about.

**Supplier Relations**

Recently we asked some suppliers what it’s like doing business with Ford. A ccord...
2005 Roundup of North American Automotive Suppliers

For a year often euphemistically described by auto industry executives as “challenging,” General Motors’ sobering announcement in January that it lost $8.6 billion in 2005 left little doubt about the severity of the troubles facing North American carmakers and the suppliers who serve them. GM’s North American automotive operations alone lost $5.6 billion for the year. Ford’s North American automotive operations reported a pre-tax loss of $1.6 billion, although profits in other regions reduced worldwide automotive losses to about $1 billion. Ford’s full-year net income for 2005 was $2 billion.

GM set aside $3.6 billion, included as a non-cash charge in the fourth quarter, to cover benefit obligations for Delphi workers, as a result of Delphi’s bankruptcy filing. Ford recorded $468 million in 2005 for Visteon related charges. Ford agreed to take back 17 plants, six offices and some research facilities in North America along with 18,000 UAW workers and 5,000 salaried employees from Visteon, which is struggling to stop continued losses.

Both Ford and GM announced plans to close several North American plants and eliminate some 30,000 jobs each—GM’s by 2010, Ford’s by 2012. In addition to extensive cost-cutting, both carmakers concede they need to focus on strengthening their brands and developing innovative vehicles that can compete with Asian and European products. According to Automotive News, GM’s light vehicle sales in the U.S. fell 4.5% in 2005; Ford’s U.S. light vehicle sales dropped 5.3%. Chrysler Group’s unit sales in the U.S. grew 4.5%.

Roundup will continue next month with coverage of Autoliv, TRW Automotive and Johnson Controls Interior Experience.

Gentex Corp.
2005 Net Sales: $536.5 million
Change from 2004: Up 6.1%
2005 Net Income: $109.5 million or 20.4% of sales, compared with 22.3% net margin in 2004

Gentex’s automotive revenues increased 6% for the year, due largely to 8% improvement in unit shipments of auto-dimming mirrors, from which the company derives 95% of its revenue. North American customers accounted for 48% of mirror shipments in 2005, one percent less than in 2004. Gentex estimates its worldwide mirror shipments will increase by 10% in 2006.

While Gentex serves most major carmakers, it depends on General Motors for a considerable chunk of its mirror business. The company extended its sourcing agreement with GM, under which Gentex will supply all but two of GM’s interior auto-dimming mirror programs worldwide through August 2009. Gentex will also supply all Mercedes and Chrysler interior and exterior auto-dimming mirrors through December 2009.

Johnson Controls Interior Experience
(Fiscal year ending September 30, 2005)

| FY 2005 Consolidated N et Sales | $18,833.2 million |
| Change from FY 2004 | up 10.7% |
| FY 2005 Operating Income | $632.3 million |
| (excluding restructuring costs) or 3.4% of Interior Experience sales, a decline of 3.4% from the prior year due primarily to higher raw material costs |

In North America, JCI’s interiors sales grew 3% in 2005 to $8.5 billion despite a slight decrease in North America of 0.5% in 2005; Ford’s U.S. light vehicle sales dropped 5.3%. Chrysler Group’s unit sales in the U.S. grew 4.5%.

Lear Corp.
2005 Net Sales: $17,095 million
Change from 2005: Up slightly, 0.8%
2005 Net Loss: $1,376 million, compared with $422.2 million net profit in 2004

With General Motors and Ford as its two largest customers, accounting for roughly 40% of sales, Lear had some formidable challenges to deal with in 2005. Sales to the traditional Big Three excluding Mercedes, Volvo, Land Rover, Jaguar and Saab business, contributed 56% of Lear’s total sales in 2005.

The company’s strategy has been to grow sales in Europe and Asia, but since 2003, sales outside North America have not increased very much. Fifty-four percent of 2005 sales were in North America, compared with 59% two years ago. Lear’s plan for the Seating and Electrical/Electronics business is to bring the geographic mix to 45% North America, 55% elsewhere by the 2008-2010 timeframe. Business with Asian OEM’s is forecast to reach about 15% of company sales by the end of the decade.

Lear’s North American content per vehicle was $586 in 2005; European content per vehicle was $347. Lear’s Electrical/Electronics business, primarily wiring harnesses, accounted for 17% of sales or $2.9 billion, in 2005 compared with 14% of sales in 2004.

The combination of customer pressure to reduce prices and higher raw materials Turn to Roundup, page 8
Background

The MathWorks was founded in 1984 by Jack Little and Cleve Moler who still own the company. Professor Moler serves as chairman and chief scientist; Jack Little is president and CEO. The MathWorks’ success as an enterprise is based on its two core software products for technical computing and model-based design, MATLAB and Simulink. The original Fortran version of MATLAB was authored by Prof. Moler, a mathematician and computer scientist who holds a Ph.D. from Stanford University. In the 1980s, working as an engineer in controls and signal processing, Jack Little recognized the opportunities presented by making MATLAB available to the growing market of PC users. He formed The MathWorks with Prof. Moler to translate MATLAB into C language and market the product commercially. Mr. Little is a graduate of MIT and Stanford University.

With more than 85 different products based on MATLAB and Simulink in its portfolio today, The MathWorks serves not only automotive but also aerospace, biotechnology, communications, defense, education, finance, and semiconductors among its core markets. Because it doesn’t rely on any single market sector, The MathWorks has weathered economic downturns well. Sales have increased every year since its founding.

The MathWorks counts more than one million users of its products worldwide. Half of all MathWorks sales come from customers outside of North America. In addition to its headquarters in Natick, Massachusetts, The MathWorks maintains offices in France, Germany, Italy, Spain, Sweden, South Korea, Switzerland, The Netherlands and the United Kingdom.

The MathWorks has no plans to go public or merge with another company. “The company has grown organically by plowing our profits back into the company’s operations, by investing deeply. We’ve never had outside help from venture capitalists or outside investors. By remaining private we can focus on the long term and make decisions that benefit ourselves and our customers,” explained Jim Tung, MathWorks Fellow and chief strategist. Mr. Tung focuses on accounts and key industries, including the automotive industry. Mr. Tung joined The MathWorks in 1988. Prior to that, he was employed by Lotus Development Corp., where he was product marketing manager for engineering products and a project that later became Lotus Notes.

MATLAB

Twenty years after its first release, MATLAB, according to the company, is today the language of technical computing, the de facto industry standard high-level programming language for algorithm development. MATLAB is also an interactive software development environment that lets engineers perform computationally intensive tasks faster than traditional programming languages such as C, C++, and Fortran. The MATLAB B product family accounts for 60% of the company’s revenues.

MATLAB tools have a wide variety of uses. For example, they can be used to...
manage code, files and data, to build programs or to solve problems. MATLAB allows engineers to run mathematical functions such as linear algebra, statistics, Fourier analysis, optimization or filtering. They can create 2-D and 3-D graphics with which to visualize data or create graphical user interfaces. MATLAB-based algorithms can be integrated with other applications written in other languages such as C, C++, Fortran, Java, C OM and Microsoft Excel.

"MATLAB is a high-level language that is also a highly interactive language, meaning the programmer writes a command which gets executed right away," explained Mr. Tung. "MATLAB can be easily extended with commands using product add-ons we call 'toolboxes.' Let's say I'm describing an optimization algorithm. I type in the algorithm in the form of a MATLAB script. Within the script I can call up functions from a signal processing toolbox, or a neural network toolbox, or an image processing toolbox, or even from a colleague doing research in that area." There are thirty-five MATLAB toolboxes available from The MathWorks and more from third parties.

Simulink

Not only do simulation tools shorten the time between design iterations, but they also make it easier to explore things that engineers wouldn't otherwise try, either for lack of time or because they don't want to damage physical models. That freedom to experiment leads to more creativity.

MATLAB is the foundation for Simulink, which was first released in 1990. Based on block diagrams, Simulink is an environment for modeling and simulation, an analytical method meant to imitate real-life systems. Sixty-five percent of The MathWorks automotive revenue comes from the Simulink product family.

The Simulink environment can be used for fixed-point and event-based modeling, control system design and analysis, signal processing and communications design and analysis and automatic code generation. Block diagrams can be extended using MathWorks add-on blocks for signal processing, communications or other blocksets, which can be dragged into the diagram and wired together. Simulink sits on top of MATLAB, which designers can use to customize or calculate or to prototype ideas that can then be simulated. The MATLAB programming language can be used to launch Monte Carlo simulations with Simulink automatically. Monte Carlo simulations generate a range of random values for uncertain variables to fully test all possible system behaviors.

With Simulink, software engineers can present system requirements not as lengthy prose statements but as mathematical models, which can be simulated, tested and verified. Using Simulink product add-ons, executable C code can then be automatically generated.

Stateflow

Stateflow is an interactive design and simulation tool for event-driven systems. Used to describe complex logic in a natural and readable form, it is tightly integrated with Simulink and MATLAB. A non-toolbox product, Stateflow Coder generates C code from Stateflow charts.

Real Time Workshop

Real Time Workshop automatically generates C code for developing and testing algorithms modeled in Simulink. The resulting code can be used for real-time and non-real-time applications including rapid prototyping, hardware-in-the-loop (HIL) testing and deployment in production vehicles.

The Automotive Market

The automotive market is a core market for The MathWorks, accounts for about $90 million in sales, which is 25% of total company sales. Sales to automotive customers have grown at roughly the same rate as total sales, 15% annually, and will likely continue at that rate for the foreseeable future, according to the company.

The demand for Simulink and Stateflow products by automotive customers correlates with demand for model-based design, an approach that is well-entrenched around the world. Given the dynamic complexity of control systems, powertrain and chassis engineers were the first to depend heavily on modeling and simulation tools. Increasingly, body electronics engineers are becoming heavy users of model-based design because of the interaction and interlocking nature of body control logic systems. Designing Bluetooth vehicle nodes that are compatible with a variety of Bluetooth phones is one particularly problematic aspect of body electronics engineering that would yield to modeling tools.

Demand for MathWorks products is growing fastest among engineers working on active safety, telematics and infotainment systems. MathWorks tools that were developed for designers working outside automotive are finding increasing use in these areas.
The MathWorks

MathWorks A utomotive A dvisory Board

One sure path to business success is to get very close to your customers, to deeply understand their needs and respond to those needs with appealing products. One way the MathWorks gets close to its automotive customers is through the MathWorks Automotive Advisory Board (MAAB) meetings, where a select group of 80 to 100 engineers from the carmakers and major tier-one suppliers meet annually under a non-disclosure agreement to discuss their experiences with MathWorks products. The most recent meeting of the group was held in Michigan, in June 2005. The 2006 session is slated for mid-May in Stuttgart, Germany.

At the first MAAB meeting in 1997, representatives from Daimler-Benz, Toyota, and Ford talked about the need to meld Simulink's dynamic models with models based on events or states, the latter accounting for much of the control system code embedded in the vehicle, for example, in transmissions and body controls. As a result of those initial discussions, in 1998 the MathWorks created Stateflow, a design and simulation tool for event-driven systems.

A nother outcome of MAAB is “C ontroller Style Guidelines for U sing MATLAB, Simulink and Stateflow,” first published in April 2001. A n evolving document, “Guidelines” is a set of best practices to unambiguously specify models so that a model is clear to both suppliers and OEMs. Mr. Tung recalled, “Our customers were asking us, ‘How do we share our design requirements and models in a way that can be understood by all?’”

While the style guide has not become a rigorously prescribed standard, all of the MathWorks’ customers, according to Mr. Tung, “have looked at it, have extracted approaches from it and either use it as is or tailor their own internal style guides based on it.”

A utomotive A pplications

Toyota: The appeal of MathWorks products was enhanced in November 2005 when Toyota and Denso collaborated to use the Real-Time Workshop Embedded Coder, the automatic software code generator used in the MATLAB/Simulink environment. That automatically generated code was applied to one of the ECUs in the Prius hybrid vehicle, the car with probably the world’s most sophisticated powertrain control software. According to Toyota, automatic code generation minimizes the need for scarce software designers and reduces engineering labor requirements by 20% to 30%. Toyota and Denso plan to use the tools in other engine control applications with expansion to other applications likely.

Jaguar: Jaguar engineers used MATLAB and Simulink to calibrate European onboard diagnostics systems. “The ease of use and statistical analysis within the Model-Based Calibration Toolbox [a MATLAB add-on] give the user opportunity to accurately evaluate many model inputs quickly,” noted Nick Wright, engineer at Ford.

General Motors: Using MathWorks tools, GM Powertrain engineers perfected the process and tools necessary to automatically generate production code from algorithm models. According to GM engineers, automatic code generation is faster, more accurate and less costly than manual coding and produces code that is slightly more compact. GM has developed innovative methods to deploy automatically generated code in a production electronic control unit in upcoming production vehicles. That effort won for GM Powertrain engineers the “Boss” Kettering Award, GM’s highest honor for technical innovation.

Nissan: Working in the States, Nissan engineers used MATLAB, Simulink and Stateflow to develop and test models of their emission control strategy. That led to certification by the California Air Resources Board of the 2000 Sentra CA as a partial zero emissions vehicle, the first gasoline powered vehicle to make that grade. By optimizing the control strategy, Nissan was also able to reduce the number of sensors used in the system. Later, Nissan engineers used Simulink to imple-
A New Product

The MathWorks recently released version one of its newest product called SimEvents. SimEvents extends Simulink with tools for modeling and simulating discrete-event systems. SimEvents will help engineers work on systems that are dependent on communications networks to see if and where there are bottlenecks. “While this isn’t the first discrete-event system tool on the market, it’s the first one that’s so tightly integrated with Simulink,” said M. R. Tung. With SimEvents engineers can model hybrid dynamic systems containing continuous-time, discrete-time, and discrete-event components, for example, sensor networks and distributed control applications.

Competing with Customers

A sk Jin Tung which companies The MathWorks competes with for automotive industry business and he’ll say “Business as usual.” Explaining what he means by that, he told us in a recent interview: “Our competition is people who think that they need physical prototypes in order to verify a design approach. It’s people who think that the only way to implement embedded systems is to write the code by hand every time. It’s people who think that testing is something you do only when you have time and only at the end of the development process when you have the implementation.”

Assessing whether other products compete directly with the MathWorks products is complex, since Simulink is a platform that supports products from many other tool vendors. A sk M. R. Tung again which companies he competes with for business in the automotive industry and he is reluctant to name any. The MathWorks has rather complicated relationships with many of the companies with whom it competes. For example, Statemate is an I-Logix product that competes directly against the MathWorks’ Stateflow product. But Statemate can connect to Simulink, a MathWorks product, and that benefits The MathWorks. Similarly, ETA S, Vector and dSPA C.E, software tool companies that also serve the automotive market, also make products that run on Simulink. Such relationships make it difficult for the MathWorks to take full advantage of new product opportunities through more vertical integration of its products.

Other Tool Vendors Active in the Auto Industry

- Rapid Automotive Performance Simulator (RAPTOR)
- Europe
  - 3Sof, Erlangen, Germany
tros ECU: an integrated concept for control devices conforming to AUTOSAR
tros GUIDE: tool for the development and code generation of human machine interfaces
- DECOMSYS, Vienna, Austria
- FlexRay network development design tools
dSPACE, Paderborn, Germany
- Engineering tools for development and testing of mechatronic control systems
- ETAS, Stuttgart, Germany
- Engineering tools, applications and services for the development of embedded automotive systems
- Vector Informatik, Stuttgart, Germany
- Networking and automotive electronics development tools and software components
Roundup...

costs led Lear to a deal with investor Wilber Ross's W.L. Ross & Co. through which Lear's struggling Interiors unit will likely be combined with bankrupt Collins & A ikman Corp.'s Interiors business. The Interiors unit accounted for 18% of Lear sales in 2005. Lear wrote off $1,095.1 million in charges related to the disposition of the Interiors business. Included in the Interiors segment are instrument panels and cockpit systems, overhead systems, door panels, flooring and acoustic systems and other products. Lear stock lost over half its value during 2005.

Visteon
2005 N et Sales: $16,976 million
Change from 2004: down 9.9%
2005 N et Loss: $270 million, compared with a loss of $1.5 billion in 2004
2006 Sales Outlook: $11.2 billion, a 34% decline from 2005
Visteon returned 20 plants and facilities in the United States and three in Mexico to Ford through a Ford-managed legal entity named Automotive Components Holding (ACH) as part of a bail out agreement reached with its former parent in October 2005. Visteon's 2005 sales include the operations of those facilities for only the first nine months of the year. Visteon recorded a gain in the fourth quarter of $1.83 billion on the sale of those facilities, which resulted in a net profit of $1.34 billion for the quarter, while sales fell 39%.

Since its inception in 2000, Visteon has yet to produce a yearly profit, but the company forecasts adjusted earnings (EBIT-R) in 2006 in the range of $45 million to $75 million. Having handed its highly paid UAW workforce and production facilities back to Ford, most of Visteon's manufacturing will now be in low labor-cost countries. Visteon is also moving more engineering offshore: in 2005, 70% of engineers were in “high cost” countries; by 2008, that percentage

For... Continued from page 2

ing to one top executive, it can be a grind. "I know some people are not bothering to go into Ford," he said, "because it is so challenging. You are competing with overseas guys and Ford plays that low-price card: 'I can get this from China or somewhere else cheaper.'"

Despite awful cost pressures, many suppliers are still very keen to do business with Ford. And Mr. Reitz welcomes their help. "We are asking our suppliers, 'How can we drive to lower costs for both you [the suppliers] and ourselves, in terms of getting some global synergies?'"

According to Mr. Reitz, Ford's next-generation navigation system has found tremendous interest from suppliers worldwide. We have learned from other sources that three Japanese suppliers are still in the running to become Ford North America's infotainment system supplier: Xanavi, Clarion and Pioneer, although Pioneer may have dropped out since lowest cost still seems to be the number-one criteria for Ford. Which one ends up with the business will be decided in March. Founded as a joint venture between Hitachi and Nissan, Xanavi is now part of Hitachi Automotive.

Ford's Family of 27 Strategic Suppliers

<table>
<thead>
<tr>
<th>Supplier Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auboviv</td>
<td>Chassis Systems</td>
</tr>
<tr>
<td>Bosch</td>
<td>Dana/GKN JV</td>
</tr>
<tr>
<td>Delphi</td>
<td>Dicastal Wheel</td>
</tr>
<tr>
<td>Johnson Controls</td>
<td>Englehard</td>
</tr>
<tr>
<td>Lear</td>
<td>Hankook</td>
</tr>
<tr>
<td>Magna</td>
<td>Johnson Matthey</td>
</tr>
<tr>
<td>Visteon</td>
<td>Kiekert</td>
</tr>
<tr>
<td>Yazaki</td>
<td>Pirelli</td>
</tr>
<tr>
<td>DuPont</td>
<td>Superalloy</td>
</tr>
<tr>
<td>Foster</td>
<td>Thai Summit</td>
</tr>
<tr>
<td>Hella</td>
<td>Tokico</td>
</tr>
<tr>
<td>Dana</td>
<td>TRW</td>
</tr>
<tr>
<td>Getrag</td>
<td>Umicore</td>
</tr>
<tr>
<td>Brose</td>
<td>ZF</td>
</tr>
</tbody>
</table>

Twenty High-Impact Commodities

<table>
<thead>
<tr>
<th>Commodities</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axles</td>
<td>Plastic bumpers</td>
</tr>
<tr>
<td>Brake systems</td>
<td>Radio and audio</td>
</tr>
<tr>
<td>Electronic control modules</td>
<td>Restraint systems</td>
</tr>
<tr>
<td>Exhaust systems</td>
<td>Seats</td>
</tr>
<tr>
<td>Exterior lamps</td>
<td>Shock absorbers</td>
</tr>
<tr>
<td>Frames and cross-members</td>
<td>Steering gears</td>
</tr>
<tr>
<td>Instrument panels</td>
<td>Tires</td>
</tr>
<tr>
<td>Latches</td>
<td>Transmissions</td>
</tr>
<tr>
<td>Latches</td>
<td>Wheels</td>
</tr>
<tr>
<td>Paint</td>
<td>Wiring</td>
</tr>
</tbody>
</table>

Correction—December 2005/January 2006
Page 5: The graph showing Harman's automotive sales and operating margin should note that the figures given are in millions of dollars, and that FY 2005 operating margin was 16.4%, not 6.4%.

Page 8, February 2006

The Hansen Report on Automotive Electronics, Portsmouth, NH USA  www.hansenreport.com