

The Company Profile... Kostal Group

Thumbnail Sketch

Headquarters: Lüdenscheid, Germany; www.kostal.com
2013 Kostal Group Revenue*: 1,940 million euros
R&D*: 7.4% of revenue
Employees: 15,110, of whom 77% are located outside of Germany
2013 Group Revenue per Employee: 128,392 euros
2013 Automotive Electrical Systems Revenue*: 1,618 million euros
Automotive Products: Mechatronic modules, switch panels and switches, electronic control units
Ownership: The company is owned by the Kostal family.
 *Planned

Background

In 2012, Kostal marked its 100th year in business. The company was founded in 1912 in Lüdenscheid, Germany, by Leopold Kostal, and is still owned by the Kostal family today. The current chairman, Andreas Kostal, who took the position in 2011, is the fourth generation to lead the company. It is company policy that a family member will be active in management to assure that the family's interests and the company's interests are aligned.

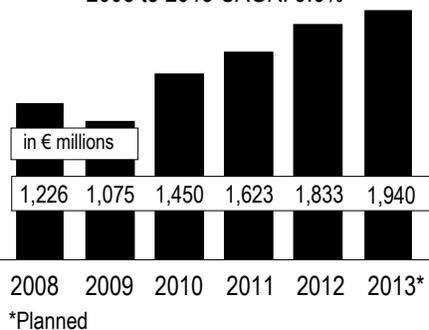
Kostal's initial product line included sockets, plugs and switches for industrial and domestic use. It produced its first automotive part, a turn signal switch, in 1927 and since 1953 has focused almost entirely on the automotive industry. Among the company's mainstay products, steering column switches have been in production for more than 50 years.

Since 1995, Kostal has been organized into four business units: Automotive Electrical Systems, Connectors, Industrial Electronics and SOMA Test Systems. By far the largest division, Automotive Electrical Systems accounted for 81% of sales in 2013.

As a family-owned operation, Kostal is not constrained by shareholder pressure for short-term profits. Carsten Wolff, vice president for automotive markets and customers, and member of the executive board noted, "Family-owned companies

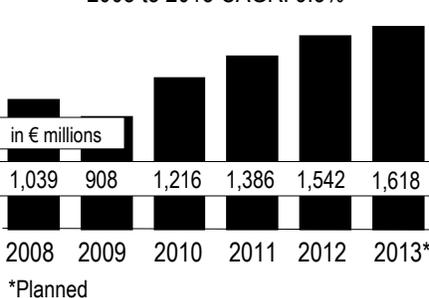
Kostal Group Revenue by Year

2008 to 2013 CAGR: 9.6%



Kostal Automotive Electrical Systems Revenue by Year

2008 to 2013 CAGR: 9.3%



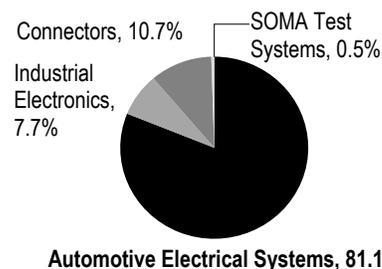
are really devoted to the long-term success of the company. That means sustainable, profitable growth is the most important guidance for all our business actions." Mr. Wolff is responsible for worldwide sales for the automotive electrical systems business. Kostal provides customers with a global footprint along with the flexibility and commitment of a family-owned and managed medium-sized company.

Strengths

Kostal's annual automotive sales growth since the start of the global recession in 2008 has outpaced the automotive electronics market. By 2010, Kostal's Automotive Electrical Systems sales had not only recovered from the global crisis, they surpassed 2007's pre-recession revenue. Kostal aims to continue its faster-than-market growth, anticipating sales over the next five years will increase at the rate of 5% to 10% per year. Not an acquisitive company, Kostal plans to continue to generate growth from within, through its core com-

Kostal Group Revenue by Business Division

2013 Total: €1,940 million



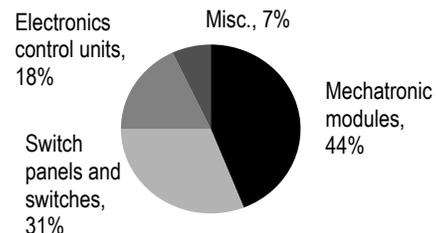
Automotive Electrical Systems, 81.1%

Percentages are based on total of revenues from third party customers plus inter-group revenues.

*Planned

Kostal Automotive Electrical Systems Revenue by Product

2012 Total: €1,542 million



petencies and by expanding into new locations.

Kostal's "Strategy 2020" targets all regions as growth regions. "The growth regions are pretty diversified," Mr. Wolff observed. "Asia is in the lead, but we are looking into North and South America and Europe as well. Our newest, 100% Kostal-owned company is Kostal India."

According to the company, its core competencies lie in what it calls integration, and that integration covers five disciplines. Kostal characterizes these as global, technical, vertical, business and human integration.

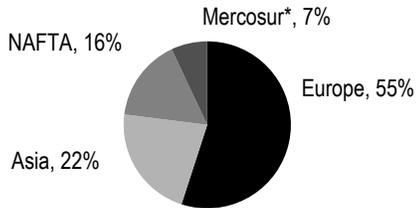
◆ Global Integration

"We think our global footprint is one of the very strongest competencies we bring to the market," said Mr. Wolff. "Not only do we have a highly distributed production and development network, we also have a highly standardized structure all over the world in terms of our processes, production equipment, tooling standards and so

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Kostal Automotive Electrical Systems Revenue by Region

2012 Total: €1,542 million



*South American Trading Block

Distinctions Claimed by Kostal

- ◆ World's first company to supply a monovision camera capable of supporting EuroNCAP advanced emergency braking requirement
- ◆ World's only supplier of a camera that directly attaches to windshield, no air gap
- ◆ First market application of rain sensors
- ◆ First market application of anti-pinch window lift motors
- ◆ Invented combination turn signal, high-beam switch
- ◆ Market leader in steering column switches, with 30% market share in Europe

on. A project might be launched in two or three regions of the world at the same time with an equal level of quality and functional requirements and still fit into local platforms."

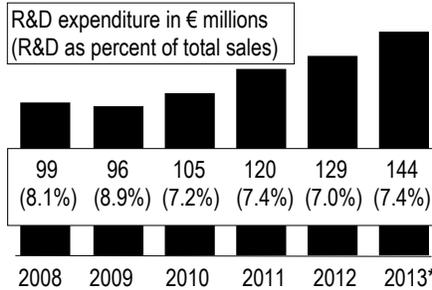
Globally, Kostal employs 1,080 engineers in R&D, product line management and project management. An additional 800-plus support production engineering. Roughly half of Kostal's engineers are based at the engineering center in Germany, with the other half abroad. Approximately 220 are at Kostal's R&D center in China and 100 in North America. The remainder are in low labor cost countries including Bulgaria, Ukraine and the Czech Republic, or supporting production facilities in Spain, England and other locations.

◆ Technical Integration

Kostal serves not just premium German carmakers, but also high-volume and low-cost carmakers. "Kostal has always fueled our growth by integrating further functionalities into existing products and by integrating different technologies, especially

Kostal Group R&D by Year and as Percent of Sales

2008 to 2013 CAGR: 7.8%



*Planned

Average Number of Automotive Employees by Country

Germany*	3,472	Ireland*	873
Brazil	1,358	Italy*	23
Britain*	492	Japan	25
Bulgaria	285	Mexico	2,017
China	2,017	South Korea	9
Czech Rep.	1,795	Spain*	675
France	16	Ukraine*	750
India	116	United States*	210

*All business areas

mechanical functions and electronics. "Mechatronics is our mission," Mr. Wolff explained. Kostal has been successful in expanding its switch and switch panel business into lower-end vehicles in developing markets such as China and India.

"Kostal is not a company that just buys technology and assembles it somehow. We really try to understand the technology we are using and we invest a lot of money in our laboratories. We promise our customers we know what we are doing," said Jörg Schwerak, vice president of R&D and engineering and member of the executive board. Mr. Schwerak is responsible for R&D, production engineering and product line management for the Kostal Group.

◆ Vertical Integration

Kostal maintains in-house competence in multiple stages of metal and plastic manufacturing as well as in pre- and final assemblies. For example, approximately 70% of injection molding is done in house, according to Ludger Laufenberg, president and CEO of the Automotive Electrical Systems business. "These are the

Major Automotive E/E Production Facilities

Brazil

Sao Paulo: mechatronic modules, ECUs, switch panels and switches

Cravinhos: switch panels and switches

Manaus: switch panels and switches

Britain

Goldthorpe: mechatronic modules, switch panels and switches

Bulgaria

Smolian: switch panels and switches

China

Anting: mechatronic modules, ECUs, switch panels and switches

Changchun: mechatronic modules, switch panels and switches

Czech Republic

Zdice: mechatronic modules, switch panels and switches

Germany

Halver: mechatronic modules, switch panels and switches

Meinerzhagen: mechatronic modules

Lüdenscheid: mechatronic modules, ECUs, switch panels and switches

India

Ranipet: switch panels and switches

Ireland

Mallow: ECUs

Abbeysfeale: ECUs

Mexico

Queretaro: mechatronic modules, ECUs, switch panels and switches

Acambaro: mechatronic modules, switch panels and switches

Spain

Sentmenat (Barcelona): mechatronic modules, switch panels and switches

Ukraine

Pereyaslav: Switch panels and switches

Sales and R&D Support Offices

France: Paris

Italy: Turin

Japan: Tokyo, Hiroshima

Korea: Seoul

USA: Troy

three most important areas in our vertical integration: manufacturing single components, electronic printed circuit boards and related assembly, and tooling. We have an in-depth competence in the manufacture of tools," Dr. Laufenberg said.

◆ Business Integration

Kostal competes with the world's largest tier ones and needs to demonstrate the value it can bring to OEM customers. The company believes it can do so in several ways. If a project is severely cost driven, for

Kostal Group

example, Kostal can work with the customer to lower system costs through integration of components into modules, to combine functions into fewer ECUs, or to design systems for more efficient manufacturing and ease of assembly. It also can leverage its in-house expertise to deliver a better end-customer experience than its competitors. "This is another dimension of integration that brings customers to Kostal," said Mr. Wolff. "If we bring, let's say, superior surfaces or superior haptics to our customers, we are integrating quality not only in terms of robustness but also in terms of the user's perception of the product."

◆ Human Integration

Kostal works to create a company culture of community, where all competencies are shared equally throughout the organization. "In addition," said Mr. Schwerak, "we have functional responsibilities. For example, I am responsible for all R&D centers, so all have the same standards, system set-ups and processes. Frank Blaesing, our head of innovation, signs off on every innovation project in the world, so we know we are not duplicating our efforts."

Product Strategy: Variety

Unlike some medium-sized companies that focus sharply on only a few technologies, Kostal's strategy is to develop and support multiple technologies, which has the benefit of exposing the company to more future market opportunities as they arise. "Customers work with Kostal rather than a specialist company working in just one field because we can clearly see the relationships among the different technology trends," Mr. Schwerak asserted. "A second reason is our internal engineering competence set up. We know we need a certain amount of electronics competence in different technology fields, so if one opportunity is not developing as quickly as we anticipated, we can apply those engineering resources to other fields. It makes Kostal a much more stable company than one working purely in, say, electromobility." Mr. Schwerak gave the example of Kostal's efforts in HMI, which have expanded from simply making switches and switch panels to include systems that must be integrated with

Kostal Group Revenue by Customer

2012 Total: €1,542 million	
Volkswagen/Audi/Porsche	31%
Mercedes/Smart	18%
Ford/Lincoln	13%
BMW	10%
Fiat/Chrysler	8%
Tata/JLR	4%
Peugeot/Citroën	4%
Geely/Volvo	1%
Mazda	1%
GM	1%
Renault/Nissan	1%
Honda	1%
Chinese OEMs	1%
Others	6%
Total	100%

the HMI, such as driver assistance and driver monitoring.

Most Promising New Products

◆ Forward-Looking Driver Assistance Camera

Kostal's first generation driver assistance camera launched on Mitsubishi and PSA vehicles in 2012. The company is working with a German premium OEM on the second generation, a world's-first mono-vision camera capable of supporting automatic emergency braking (AEB), and braking for pedestrians, without the need for a radar sensor to detect range. The new camera complies with Euro NCAP requirements for model year 2014 vehicles to earn five star ratings. The mono-vision camera system is scheduled to go into production at the end of 2014.

A unique feature of the camera is that it attaches directly to the front windshield, eliminating any air gap where dust or moisture could compromise performance. Unlike mirror-mounted solutions, the optical path realized by mounting the camera directly to the windshield (a heated windshield is required) is sufficiently reliable for safety-critical functions. The field of view captured is comparable to the visual perception of the driver.

Driver assistance algorithms, supplied by Mobileye, use multiple, sequential images taken by the camera to compute the exact time to collision with an object, rather than measuring distance to the object. "To do

emergency braking, applying full braking force, requires an ASIL-based sensor," explained Frank Blaesing. "You need redundancy in your sensor. This is not one single algorithm doing all the calculations. There are different algorithms on different information channels inside the sensor. Only if the redundant algorithms come to the same conclusion is the braking action carried out." Kostal has had an ongoing partnership with Mobileye since 2001.

Future camera applications in development include both driver monitoring and gesture recognition systems based on 3D time-of-flight cameras from PMD Technologies. Time of flight image sensors use light pulses from an LED or laser to measure distance. Kostal is developing its own gesture recognition algorithms for infotainment controls.

◆ Intelligent Surfaces

Despite the problems Ford encountered with its MyFord Touch and MyLincoln Touch controls, Kostal believes capacitive switching is one of its more promising new technologies, worthy of considerable investment funding. Ford's touch capacitive switches were not supplied by Kostal. "With capacitive switching you can make the switches invisible when you are not using them; you create a certain design in the interior of the car," said Mr. Schwerak. Which functions are most appropriate for capacitive switching? According to Kostal, certainly not all of them and none that would be operated in emergency situations, such as switching on hazard lights, but possibly functions that can be personalized for the driver such as Home in a navigation system or a Call Home button.

Kostal's capacitive switches are designed to make it difficult to activate them unintentionally. "In our system you can locate the switch with your hand first; every control has some kind of tactile, physical shape," explained Harry Asher, vice president for product line management and engineering. "The sensor is aware of where you are touching the surface, but you have to apply force to the switch to get the activation. You have more or less a normal switch experience,

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Kostal Automotive Products

Mechatronic Modules

Steering Column Modules

- Steering column modules
- Cruise control switches
- Steering angle sensors
- Rotary connectors
- Electronic gear shifters on column
- Electrical steering locks (China)

Roof Modules

- Roof modules
- Switch panels in roof
- Ambient lighting
- Anti-theft modules (Brazil)

Center Consoles

- Mechatronic gear shifters
- HMI controllers
- Touchpads
- Integrated HMI center console modules

Driver Assistance

- Driver assistance cameras
- Rain and light sensors

Electronic Control Units

Body Network Control Units

- Electronic park brake control units
- Keyless-go systems
- Electronic ignition switches
- Vehicle tracking systems (Brazil)

EV remote controls (China)

Interior Control Units

- Power window units
- Power window switches with integrated electronics
- Centralized power window units
- Seat memory and control units

Power Application Control Units

- Battery chargers
- Charge interface units
- DC/DC converters

Switch Panels/Switches

Switch Panels and Faceplates

- Switch panels
- Steering wheel switches
- Faceplates

Switches

- Power window switches
- Seat adjust switches
- Rotary light switches
- Single switches
 - Park brake
 - Mirror adjust
 - Start stop
 - Canopy top
- Handle switches for motorcycles

but the activation is behind a closed surface.” Kostal’s first application of these switches will be in 2015, for a German luxury carmaker.

With its in-house capabilities in plastics, foil printing, thermoforming and back- and over-molding, Kostal can offer panel surfaces that have no gaps, are less likely to crack, have a high chemical resistance, and a limited “self-healing” property. When the panel surface is heated to 50 degrees C for 24 hours, any small surface scratches disappear. Kostal markets this surface technology for capacitive switch panels under the name Kostal skintec. The company believes the quality and design of its capacitive switch panel surfaces translates to perceived high quality for consumers and brand differentiation for OEMs.

According to Dr. Laufenberg, Kostal’s demonstrations of capacitive switching at the Frankfurt Auto Show in 2013 were well received. “We had great feedback from our customers. We put a lot of upfront engineering work in our design and development and so it works well in any conditions in the vehicle environment. I see more applications based on capacitive switching integrated with intelligent

surfaces in panels. It is the dream of every designer,” he said.

◆ **Onboard Charger**

Kostal is the main supplier of onboard battery charge controllers for all of the Volkswagen Group’s plug-in hybrids and battery electric vehicles. In developing the onboard charger, Kostal tapped into the high-voltage expertise in its Industrial division, which supplies power converters to the solar energy industry. “Two years ago we merged that competence with our automotive electronics knowledge and developed this onboard charger that we are now running in series production,” noted Mr. Schwerak.

Kostal’s charger unit supports power line communications (PLC), CHAdeMO, CAN and LIN communications standards. In the future, according to the company, PLC could be employed for billing purposes. The unit could also operate bi-directionally in the future, for example, to provide back-up power from the vehicle to a home during power outages.

Although Mr. Schwerak has very low expectations for the electric vehicle market taking off any time soon, “We see a massive increase in plug-in hybrids as a result of

CO2 and fleet fuel consumption regulations. Every OEM is bringing a hybrid version to almost every car line in order to meet those new requirements. You need a plug-in hybrid, not just a hybrid that charges the battery with the engine of the car.” The company is working to expand the charger business to other carmakers, but thus far has no contracts.

◆ **Fragrance system for the S Class**

More than seven years ago, Kostal started developing a system that could deliver a selection of fragrances inside the vehicle. That system came to the market in 2013, as an option on the all-new Mercedes S Class. Kostal’s approach in the S Class is to atomize liquid fragrance, which is stored in a bottle in the glove compartment, three millimeters in front of the cabin air vent, to prevent the aroma from building up in the seats or other soft surfaces. Electronics control the frequency of the fragrance injections, which can be adjusted by the driver to increase or decrease the intensity of the smell. The system takes the cabin temperature into account in determining the precise amount of liquid to dispense.

What might seem frivolous or extravagant in Western markets is far more commonplace in Asia, according to Kostal, not only as a means of masking poor air quality but also as a distinguishing luxury feature. But Kostal also sees the fragrance feature as part of a larger future trend toward more intelligent HMI, and cars that will increasingly make adjustments to the in-vehicle environment to support the well-being of the driver. “The car HMI will adjust things like loudness, illumination or smell according to the driving situation or the mood of the driver—whether his mood is good, bad, aggressive, tired, etc. It will make some features available only if you are driving at 100 mph, others only when your speed is very low,” Mr. Schwerak predicted.

He sees a role for intelligent HMI in future autonomous or partially automated driving systems that will need to monitor the driver to assure he can be brought back in control of the vehicle as needed. “An intelligent HMI can help with that,” said Mr. Schwerak, “adjusting the car environment with the appropriate air quality or illumination or other features.” ◆