A global market review of automotive instrument panels and clusters

November 2002
A global market review of automotive instrument panels and clusters - sample

Author: Matthew Beecham
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Tel: +44 (0)1527 573609, Fax: +44 (0)1527 577423. Email: oliver@aroq.com

Aroq Limited
Registered in England no: 4307068
Seneca House, Buntsford Hill Business Park, Bromsgrove, Worcs, B60 3DX, UK.
Tel: +44 (0)1527 573 600 Fax: +44 (0)527 577 423 Web: www.aroq.com

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Chapter 1 Introduction

The engineering challenge: clutter-free cockpits

The fascia (or dashboard) and the instrument cluster together form the instrument panel. The instrument panel is a complex system of coverings, foams, plastics and metals designed to house various components and act as a safety device for the vehicle occupants. It consists of the substrate, skin, foam/padding, knee bolster, glove box, HVAC ducting and vents, trim, instrument cluster and console.

The area directly in front of the driver and front seat passenger is commonly referred to as the cockpit. It is an area that continues to expand. Despite the smooth lines and simple appearance, the cockpit is one of the most complicated and tightly packaged assemblies in a vehicle. It is also one of the most inaccessible. The cockpit may contain 50% of the total vehicle wiring system and most of the vehicle functions are controlled from this area. With several hundred individual components, it is also one of the most common sources of quality problems. The standard of design and manufacture is therefore critical.

The general appearance of fascias is a complete series of curves continuing the design shape from the cockpit through to the doors. The increase of sophisticated on- and off-board navigation systems, collision warning systems and safety and security items that need to be accommodated, together with ever more advanced in-car entertainment systems, all suggest that this part of the interior is still in its infancy in terms of development. The challenge is to find more space in the cockpit to fit yet more features such as Internet, e-mail and fax equipment. Although there can be no doubt that drivers of the future will be better informed with a raft of new instrumentation, there is some concern as to whether their instrument panels will be a safe place to deliver the information. Spurred on by the fact that between 1985 and 2005 the number of drivers over 65 on both sides of the Atlantic is likely to increase significantly, the major interior designers are working on projects to make the cockpit easier to use for the older motorist.
Figure 1 A cockpit design by Visteon

Visteon defines a cockpit system as the physical and functional interfaces of plastics, vehicle structure, electronics, electrical architecture, steering and climate systems, designed and engineered with a customer focus to deliver style, safety and security, comfort, craftsmanship and convenience.

Source: Visteon

Report coverage

Continuing our popular series of component market studies, this exclusive just-auto.com report reviews these key market drivers for vehicle instrumentation and fascias, and will provide you with forward-looking analysis.

Chapter two identifies the market trends in this sector, determining some market positions and shares of the OE instrument panel and cluster segments in each major car-producing region.

Chapter three sets out some recent innovations and analyses the forces driving them, observing some key design, styling and material trends.

Chapters four to thirteen provide brief profiles of the major manufacturers: Collins & Aikman, Delphi Automotive Systems, Denso, Faurecia, Johnson Controls, Lear, Magna, Peguform, Siemens VDO & Visteon.
Chapter 2 The market

Market overview

As more electrical and electronic systems are squeezed into the already overcrowded cockpit area, so the wholesale unit value rises. A ‘fully loaded’ cockpit typically brings together a number of important systems, including heating, ventilation and air conditioning, airbags and safety systems, steering columns and systems, instrumentation and instrument panels, navigation and entertainment systems. Faurecia’s cockpit for the VW Touareg, for example, includes the dials, electric wiring, pedal assembly and instrument panel. Industry sources suggest that a cockpit for the VW Golf would be around $xxx - $xxx, loaded with instrumentation, wiring and air conditioning, of which the air conditioner would account for around $xxx and the instrument panel shell $xxx. But precise values vary from one model to another.

Despite the extent to which instrument clusters have improved over the last decade, the wholesale cost to the vehicle maker has fallen due to the year-on-year downward pressure. The consensus is that the average cost of a printed circuit board (PCB) instrument cluster has fallen by xx% - xx% since 1990. Manufacturers talk of a standard instrument cluster at wholesale worth $xx - $xx. The cost of a reconfigurable instrument display, however, is estimated to be at least four times as much as a standard instrument cluster.

In addition to these trends, like most other component sectors, the instrument panel industry is consolidating. In the mid-1990s, there were about xx tier one suppliers of instrument panels. Today, there are about xx. In 199x, Lear gained instrument capability through its acquisition of United Technologies division. In the same year, Visteon achieved a double coup when it bought Plastic Omnium’s vehicle interiors business for FFr x billion. Following regulatory approval in July 199x, Visteon became the European market leader in automotive cockpits and reduced the share of its turnover realised with Ford from xx% to xx% in 20xx. In 20xx, Visteon’s sales to Ford accounted for xx% of its total turnover.
One of the most recent consolidations occurred between Collins and Aikman and Textron's automotive trim business. In 2002, Collins & Aikman Corp became one of the world's largest makers of automotive interior components following its $1.3 billion purchase of Textron Inc's automotive trim business (TAC-Trim). The deal nearly doubled Collins & Aikman's annual sales to $3.9 billion, lifted employment to more than 25,000 people at 123 locations in Europe and North and South America, and boosted the firm's range of polyurethane-based products.

Today, the main suppliers include: Faurecia, Johnson Controls, Collins & Aikman, Lear, Siemens VDO, Peguform, Visteon, Delphi, Toyota, Calsonic Kansai, Suzuki and Mitsubishi Belt Ltd.

Instrument panels - Europe

Following its acquisition of Sommer Allibert, the French group, Faurecia, claims to lead the European instrument panel market, worth some $1.4 billion annually. In second place is Visteon, thanks to its acquisition of Plastic Omnium's vehicle interiors business for FFr 3 billion in 1999.

Johnson Controls and Interier Automotive also have a strong presence in the European automotive instrument panel market. In 2001, Johnson Controls acquired the automotive business of French company, Sagem, which specialises in software and systems engineering crucial to the design of a car's electrical and electronic systems architecture. The €500 million acquisition plays an important part in Johnson Controls' plan to supply fully integrated cockpit and interior systems. The acquisition also gives Johnson Controls a new base in the European marketplace from which to sell its full range of electronics, opening up new business with Peugeot and Renault, Sagem's two largest customers.
Table 1 Main suppliers of instrument panels in Europe

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Source: Industry sources, just-auto.com

Instrument panels - North America

In North America, Visteon leads the vehicle instrument panel market, estimated to be worth $1.5 billion annually, followed by Collins & Aikman, Delphi and Toyota with double-digit shares. There are then a long tail of other suppliers, including Intertec and Faurecia. Intertec Systems is a joint venture between Inoac Corporation of Japan and Johnson Controls.

Instrument panels - Japan

In Japan, Toyota, Calsonic Kansai, Suzuki and Mitsubishi Belt Ltd lead the instrument panel market. Other manufacturers include Inoac, Suzuki, Toyoda Gosei, Suriyo Plastics, Nishikawa Chemicals, Honda and Shigeru Industries. Mitsubishi Belt, a manufacturer of automotive belts and plastic products, has a joint venture with Visteon to develop, manufacture and market plastic components for cockpit modules. In February 2000 Sommer Allibert (now part of Faurecia) entered into a joint venture with Inoac Corporation to manufacture and supply instrument panels and door panels to the Japanese carmakers.
Instrument clusters - global

Denso claims to be the world's largest producer of instrument clusters with a 15% share. On 2nd July 2001, Denso produced its 200-millionth instrument cluster. Denso has held the number one world market share in instrument cluster production since 1988. Siemens VDO also claims world leadership but was unable to substantiate its claim. Other manufacturers include Visteon, Delphi, Magneti Marelli, Yazaki, Nippon Seiki and Calsonic Kansei.

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Figure 2 Shares in the global OE instrument cluster market, 2001
(% of volume)

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Sources: Industry estimates, just-auto.com analysts
Chapter 3 Technical Review

Design Trends

The way in which instrument panels are designed and manufactured has changed considerably over the past decade. Recent trends such as increased size and complexity, as well as seamless airbag designs have put pressure on suppliers of thermoplastics to provide new formulations that offer:

- Improved mechanical properties for higher performance or thinner wall designs;
- Opportunities to lower costs through components integration and reduced materials usage; and
- The potential for higher manufacturing productivity via faster cycle times.

Materials suppliers have responded with a variety of new products, in many cases designed specifically for instrument panel applications.

Johnson Controls claim that uniform patterns on the surfaces of instrument panels are a thing of the past. The US interior parts maker has developed a technique to emboss different grain patterns onto the surface next to each other in one working step. The so-called In-Mould Graining technology was developed as an alternative to the traditional laminating technologies used for dashboards in mid-range cars. The process will start to be used in 2004.
Figure 3 Cutting a dash: new dashboard textures from Johnson Controls

Source: Johnson Controls

Another trend in the instrument panel segment relates to safety issues in airbag technologies. Manufacturers are introducing integrated, seamless airbag covers, which increase occupant safety. Lear points out that future trends in the instrument panel segment will continue to focus on safety with the introduction of innovation such as knee restraints and energy-absorbing substructures.

Car interior designers are also gradually moving away from the traditional dashboard mounted fresh- and warm-air grilles towards a more indirect climate control.

A typical solution is Valeo’s ‘soft air diffusion’ concept. This runs a ventilation screen the length of the dashboard near the windscreen, liberating 30% of the instrument panel surface and giving faster warming and cooling but without draughts. This sends out a blanket of cool air evenly and silently throughout the cabin, effectively eliminating cold drafts.

By rethinking the design of a conventional air conditioner unit, Valeo’s engineers have come up with a so-called soft air diffusion system that sends out a blanket of cool air evenly and silently throughout the cabin, effectively eliminating cold drafts.

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Material trends

Vinyl (polyvinyl chloride or PVC) has been used to make automotive instrument panel skins since the 1960s. It is versatile, cheap and available in a wide variety of forms. Apart from the fact that it can cause fogging under high UV light loading, the main problem of using PVC is that it is environmentally unfriendly, posing major problems when it comes to disposal. Consequently, alternative materials have been used, such as polyurethane (PU) and thermoplastic polyolefins (TPO).

Over the last few years, manufacturers have reduced their use of PVC for panels and coverage in favour of polyurethane spray and slush moulding in North America and Europe. It is forecast that polyvinyl use in instrument panels will decline to about half of all vehicles by the end of this decade. It currently accounts for about 75% of the North American market. The move comes in response to calls from vehicle makers who want materials that are less prone to fading and more recyclable.

GM and Ford have already set target dates to eliminate PVC from instrument panel production. Slush moulding and polyurethane spray provides more styling flexibility, enabling the instrument panels to be manufactured with sharp corners and more detailed features. That is not possible with the thermoforming process, although negative thermoforming is becoming popular. Negative thermoforming improves interior quality, recyclability and cost effectiveness.
The first step of the manufacturing process involves heating the thermoplastic olefin skin, which takes less than a minute. The heated skin is then drawn into a nickel tool, which shapes the skin to fit the instrument panel and imprints the grain and lettering by using vacuum pressure. Once the skin is shaped and grained, it is quickly cooled and can be attached to the substrate of the instrument panel. Negative thermoforming is able to draw more deeply into the skin of the material to create a more highly crafted instrument panel with uniform grain patterns.

**Figure 4 Visteon’s negative thermoforming process**

Source: Visteon

In the US, Dow Automotive recently installed a new polyurethane long-fibre injection-moulding machine at its automotive research and development facility in Modeland. The machine processes glass-fibre filler and polyurethane liquid together and moulds them into shape as they react together. The process makes the manufacture of larger structural components possible through injection-moulding, with higher than usual strength and rigidity. Early development work with the technology will focus on the manufacture of large structural components such as pick-up truck end gates. However, Dow intends to make instrument panels, interior trim components and NVH (noise, vibration and harshness) components from the technology.
These trends have created new opportunities for materials and families of resins that are recyclable. In June 2002, Visteon received a top Environmental Excellence award from the Society of Automotive Engineers in the US for its new fully recyclable olefinic instrument panels. Not only is the process environmentally friendly, but Visteon says it cuts operating costs as well.

The panels are produced by Visteon’s Laminate Insert Moulding process that manufactures soft-panelled products with a ten-year durability rating as well as 100% recyclability. During the laminate moulding process, a pre-formed laminate skin is inserted into a horizontal moulding press before the injection cycle. The resulting product is a one-piece moulded polypropylene instrument panel skin with selective soft touch zones. This process enables the company to build cockpits while integrating smaller components to help reduce weight and improve upon noise and vibration. Visteon currently uses this moulding process at its facility in Saline, Michigan to manufacture instrument panels on the Mazda Tribute SUV.

Cockpit trends

For some time, cockpit designers have been working on ways in which to display more information yet make the dash appear less complex. The general approach is to ensure that only the most essential information is displayed while remaining features are available in the background or brought up at will. But the increasing fitment of sophisticated mobile multimedia systems, as well as safety and security items suggest that this part of the interior is still in its infancy in terms of development.

The challenge is to find more space in the instrument panel to fit yet more features, as a cockpit designer said: “The engineering challenge is to give the driver the information and features he needs without making him feel overloaded or distracted while driving. It’s things like moving DVD players to the headliners, relocating traditional under-dash components or making them smaller and doing more multiplexing. It’s all about freeing-up a few more millimetres of space for the designer.”
To help them achieve this, Delphi is supplying an under-the-floor climate control system for the fourth generation Renault Espace, releasing up to 50-litres of in-dash space. The system, mounted under the floor and beneath the front passenger seat, directs air through ducts extended to the first row of rear seats, circulating air evenly throughout the vehicle cabin. It also means initial installation is easier and the system is more accessible for subsequent servicing. Production for this €100 million contract began in July 2002 at Delphi’s thermal facilities in Poland, France and Hungary.

The desire for a spacious interior, something always equated with luxury, is prompting interior designers to use new combinations of electronics and mechanical functions to modify or move pre-existing systems like heating/cooling and audio facilities. In terms of controls, touch-screens offer space-saving possibilities, but designers are faced with the problem of distracting the driver’s attention too much. Some designers are looking to voice recognition devices to enable them to eliminate many controls that have traditionally been manually operated. Other designers have decided to return to basics in building instrument panels, and are trying to logically prioritise the functions that drivers need most. For them, the design process starts there.

Siemens VDO’s new cockpit study ‘Pure Vision 2.0’ aims to demonstrate that tomorrow’s car cockpit does not have to distract the driver’s attention from the road with an array of screens and buttons. The central elements of the new cockpit study are a 10-inch display, controller and a large control knob. The controller serves as the central operating element by which most of the functions are selected from a menu. By pressing and turning the main control button, the driver can activate all of the main creature comfort functions as well as the navigation and multimedia systems.

Siemens claim that the display itself, with backwall projection, minimises the installation space required. It can also be adapted to the surface of the cockpit without the image being distorted. No matter from which direction the driver or passengers view the monitor, the display always appears with high colour brilliance and high contrast.
With Siemens’ new cockpit, dash-mounted air outlets are no longer required. Instead warm or cold air enters the cabin through a gap between the mount and body of the cockpit, creating new degrees of design freedom. The crescent steering wheel enables the driver to get an unhindered view of the simple instrument cluster arrangement. It is lightweight, too. The high level of integration means that very few electrical conductors are required inside the cockpit. The conductors for the connections to the vehicle are embedded in the foamed plastic. As a result, this ‘no wire’ concept eliminates the need to insulate the leads, offering reduced weight.

Instrumentation trends
Superficially, instruments appear much the same today as they did 30 years ago, but they have changed extensively in that time and are likely to change even more in the future. In the 1960s, instruments were mechanically driven. By the 1980s, most were electronic. Subsequent advances in printed circuit boards (PCB) enabled more integration of instrumentation. One PCB now controls the whole instrument cluster.

The speedometer itself dates back one hundred years. On 7th October 1902, engineer Otto Schulze at the Imperial Patent Office in Berlin patented the eddy current speedometer. The invention marked the introduction of measuring instruments in the car. However, the measuring device was still expensive so it appeared as optional equipment.

In 1910, Ford made the speedometer standard equipment. By the 1930s, the first instrument ‘cluster’ appeared; a bracket was mounted to the steering column with the speedometer, engine rev counter, fuel gauge, lights and indicator turn signals attached to it.

In the 1950s, electric speedometers were introduced by VDO for city buses. Instead of communicating wheel revolutions by means of a lengthy shaft, the rotational speed of the wheel or transmission was transformed into an electric signal with a dynamo. An electric motor on the speedometer then used this current to move the needle.
Parallel to this development, VDO developed a moving coil instrument in which the voltage of the current generated by the dynamo is displayed as the current speed. A stepper motor was developed to drive the odometer. It all fitted into an 80-millimetre housing that remained the worldwide speedometer standard well into the 1980s.

The age of the electronic speedometer began in the 1980s. Roller counters for mileage were replaced by liquid crystal displays. Sensors in the vehicle network took over the role of shafts, dynamos and rotating magnets. Stepper motors transformed electrical pulses into pointer deflections using electronic control systems. All the components were grouped tightly together in the driver's line of sight. At a glance, the driver could monitor complex information with a choice of classic round instruments, text-based displays, indicator lights and large monitors, or LCD for navigation and communication.

The invention of the light emitting diode, or LED, opened up completely new solutions for the illumination of the instrument panel.

**Figure 5** In 1986, VDO supplied Volkswagen with the first fully digital driver information system

Today, a car's instrument cluster typically features two large instruments showing speed and engine revolutions and two smaller instruments showing engine temperature and fuel gauge. A set of event lights dotted across the instrument cluster also warns the driver from time to time, such as headlamp main beam, indicator turning or handbrake on.
The instrument cluster of some high-end cars also includes navigation instructions, audio controls and telephone directories, all gradually being relocated from the centre console. Some screen displays even create three-dimensional graphics on a high-resolution thin film transistor (TFT) monitor.

Mechanical warnings may also appear on some instrument clusters, with supplementary information available in several languages. Some powerful computing is required for the first electronic instrument clusters. A modern luxury car’s instrument cluster may feature a 32-bit RISC processor, 40 megahertz clock frequency, one megabyte main memory and up to eight megabytes of data and video RAM. This on-board computer is networked into the vehicle via CAN (Controller Area Network, the data bus in the vehicle) and MOST bus (Media Oriented Systems Transport, the multimedia data bus in the vehicle). The main printed circuit board is fitted with about 600 components.
While conventional displays and gauges incorporate backlit panels with incandescent lamps as light sources, the gauge pointers have been treated with phosphorescent additives to glow in the dark. Since 1995, manufacturers have been using light-emitting diodes (LED) as light sources for more uniform light that illuminates the entire indicator without the brightness fluctuating every time the pointer is deflected.

Other benefits include longer life expectancy, which is generally the life of the vehicle, the flexibility and availability of different colours, and the fact that the illumination does not change with voltage variation such as dimming the headlights.

Another trend is the increasing use of self-illuminating displays based on organic and inorganic materials that eliminate the need for separate backlighting. Siemens VDO uses a white electro-luminescent film on the speedometer dial of the Mercedes-Benz E-class. Parallel to this, the company is also working on a projection display in which the surface of the cockpit is used as a projector screen, allowing the interior designer to accentuate the appearance of the cabin at night. Another design twist of this work is that when the car is parked, the instrument cluster is invisible.
In 2003, Siemens VDO plan to introduce the first programmable colour head-up display into production, thereby expanding the display area of the instrument panel. The driver will be able to read information on speed, vehicle condition and navigation on the windscreen.

Manufacturers also note that the retro-looking instrument cluster is making a come back. An auto executive said: “We’re seeing a lot of demand of retro products these days. Black numbers on a white background are also seeing demand. We’re also seeing different number fonts. Black numbers on a white background are also seeing more. Sample only – to order your copy of the full report call Oliver Wilkinson now:

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Another promising area under development is reconfigurable instrument clusters. Some component manufacturers, such as Delphi, Lear, Valeo, Siemens VDO and Visteon are developing instrument panel display systems that will allow the driver to re-design the instrument cluster and its gauges. Using projected image technology, incorporating all the electronic displays in one cluster and in a preferred language, the information can be wholly customised. The display sizes can be altered or eliminated while others can be added. Most systems will offer high-quality images that are easy to see and read while the programming will be made as simple as possible.

For example, Visteon’s reconfigurable projected image display allows the driver to swap the digital clock for an Internet browser, navigation system or a back-seat ‘baby watch’ feature at the touch of a button or even a voice command. Each gauge can be changed to suit individual taste. For instance, the speedometer can be selected on the basis of size, colour and language. For those who prefer analogue appearance, Visteon’s technology can provide

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A global market review of automotive instrument panels and clusters
Figure 7 Instrument cluster for the new Mercedes-Benz E-class

Siemens VDO's instrument cluster for the new Mercedes-Benz E-class combines analogue instruments with a circular central display.

Source: Siemens VDO
Chapter 4 Collins & Aikman

Since being bought-out in 1989, Michigan-based floor- and wall-coverings manufacturer Collins & Aikman has re-positioned itself as a specialist automotive carpets, acoustics and plastics supplier. Following a series of major European acquisitions, including Courtaulds Textiles, Collins & Aikman employs 25,000 people in 15 countries at 98 manufacturing and warehouse facilities, ten design centres and 17 technical centres.

Product range
The company’s vast range of interior trim products includes instrument panel systems. The company designs and makes plastic-based automotive interior trim systems and components, including door panels, headrests, pillar trim, floor console systems and instrument panel components. In 1998, the company acquired Collins & Aikman Plastics (UK) Limited (previously named Kigass Automotive Group), which increased its capacity to provide plastic-based trim and systems in Europe.

Annual sales
Collins & Aikman Corp. has become one of the world’s largest manufacturers of automotive interior components following its recent $1.3 billion purchase of TAC-Trim, Textron Inc.’s automotive trim business. The deal nearly doubled Collins & Aikman’s annual sales to $3.9 billion and boosted the firm’s range of polyurethane-based products.

TAC-Trim
Collins & Aikman claims to be the global leader in automotive floor and acoustic systems. TAC-Trim had sales of $1.87 billion in 2000 and is one of the world’s leading suppliers of fully integrated cockpits, and a major manufacturer of automotive parts, including instrument panels, interior trim and exterior components. In contrast to Collins & Aikman, TAC-Trim’s polyurethane capabilities are focused on foam-based instrument and door panels and headliners.
Reaction injection moulding is another key technology for TAC-Trim. Collins & Aikman has several plants with significant polyurethane operations that focus on carpet insulation and noise, vibration and hardness control systems. Collins & Aikman also has a Spray Urethane Barrier technology which can be moulded to meet complex design requirements.

**GM compact car win**

Collins & Aikman recently won an interiors business contract from GM to supply the floor console, instrument panel and related components for the vehicle maker's next generation of compact cars, beginning in the 2005 model year. The instrument panel will be produced at Collins & Aikman's operation in Rantoul, Illinois, while the floor console production will be carried out at its Sterling Heights, Michigan facility.