As the emphasis on the passenger experience intensifies, OEMs and suppliers strive to tackle a lengthening list of seating requirements. *ATTI* discovers the latest analysis methods and tools being adopted in seat development

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Seat first

MAIN AND INSET: Following expansion of its seat durability laboratory, Millbrook can now test 25 seats simultaneously, using pneumatic test rigs, and single or multi-axis vibration rigs

When engineering a new vehicle seat, the list of key requirements is ever-expanding. Whether it's for application in a hatchback or a sedan, a CUV or an SUV, a truck or a van, developers must undertake a raft of tests to ensure a seat meets every item on the specification. As a result, the average seat production program can typically last five to seven years, according to Magna Seating's global vice president for advanced technology engineering, Dino Nardicchio.

"There are, of course, outliers to that rule of thumb," he says. "A seat R&D program varies, depending on the near-term or long-term focus. It can range from 12 months to several years, depending on the complexity."

BELOW: Robots can mimic the most common ingress and egress paths, and are an effective way of evaluating durability aspects

For the automotive seating supplier, 60-70% of its research focuses on near-term or incremental innovations that will provide cost or performance enhancements for customers. The rest of the time is spent on "disruptive innovation to create game-changing technologies, which will alter the way we view seats and the experience people have in the vehicle cabin", according to Nardicchio.

When evaluating an all-new vehicle seat design, objective analysis is a requisite, but subjective factors must also be carefully scrutinized and are covered in a suite of abuse, comfort and ergonomics tests. Nardicchio says, "In our abuse clinics, we ask people to try to misuse or abuse the seat in an attempt to identify additional failure modes that lie outside of normal circumstances.

"In terms of egress entry testing, we test with small, medium and large people, both male and female, as well as robots, to identify true, real-world pain points or failure modes."

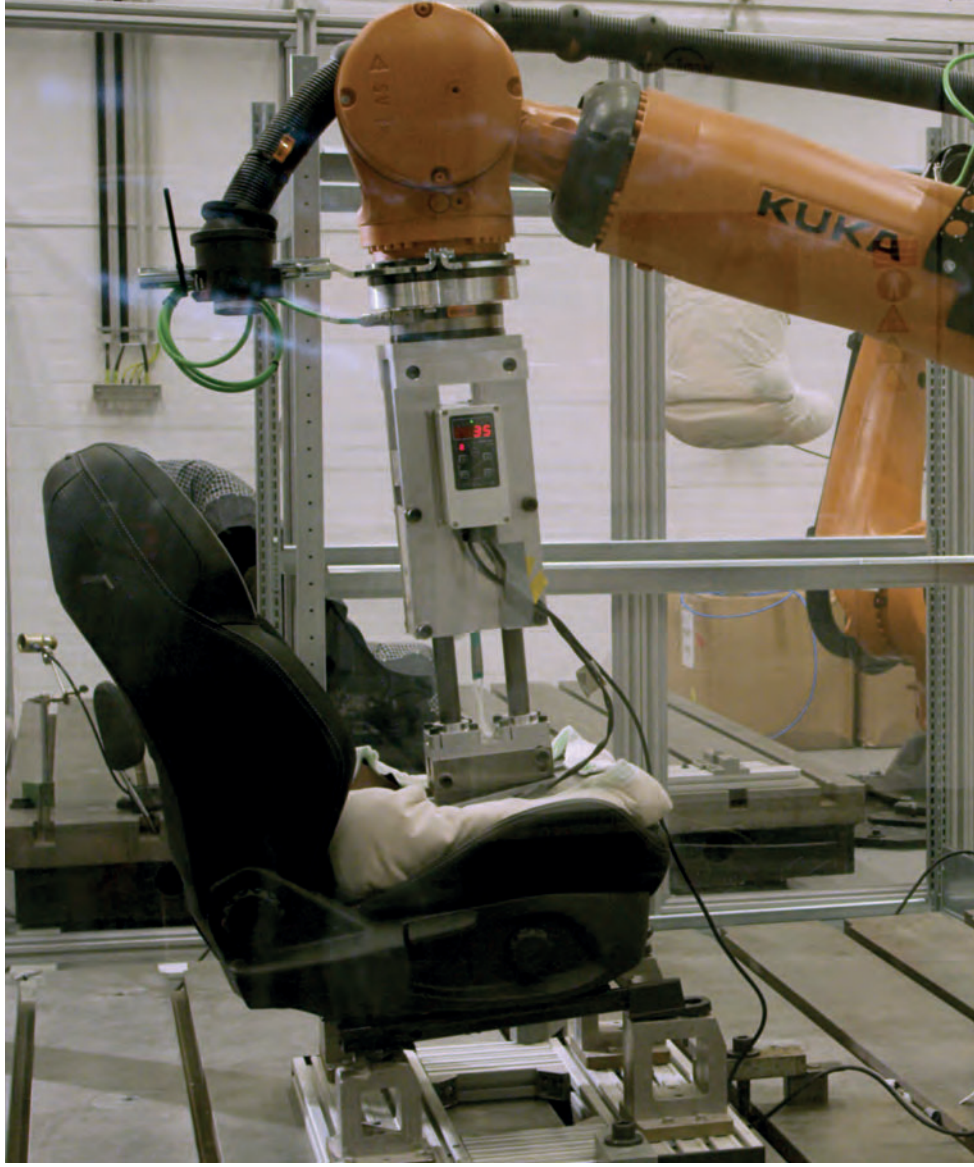
Nardicchio explains that many anthropometric standards are based on military people, who tend to be fit from a weight standpoint, which is unrealistic for many real-world situations. "Therefore we work with a range of differently sized people to ensure that performance clearly meets the standards, but that the seat can also perform at the highest level with a variety of individuals.

"For instance, using Jack software we test seat actuation with both children and fifth-percentile women to determine if a seat is truly easy to use or if it is too difficult for them to move while operating a particular feature."

In addition, analysis work usually includes a battery of textile tests, which are performed using in-house developed methods.

One example of an unconventional form of abuse testing, conducted during the program for the company's integrated child seats, involved gummy bears being left on the seats and having Cheerios crushed into them.

Ongoing research and development at Magna focuses on addressing occupant pain points based on consumer clinics and ethnography sessions held globally. These can range from things like enhancing

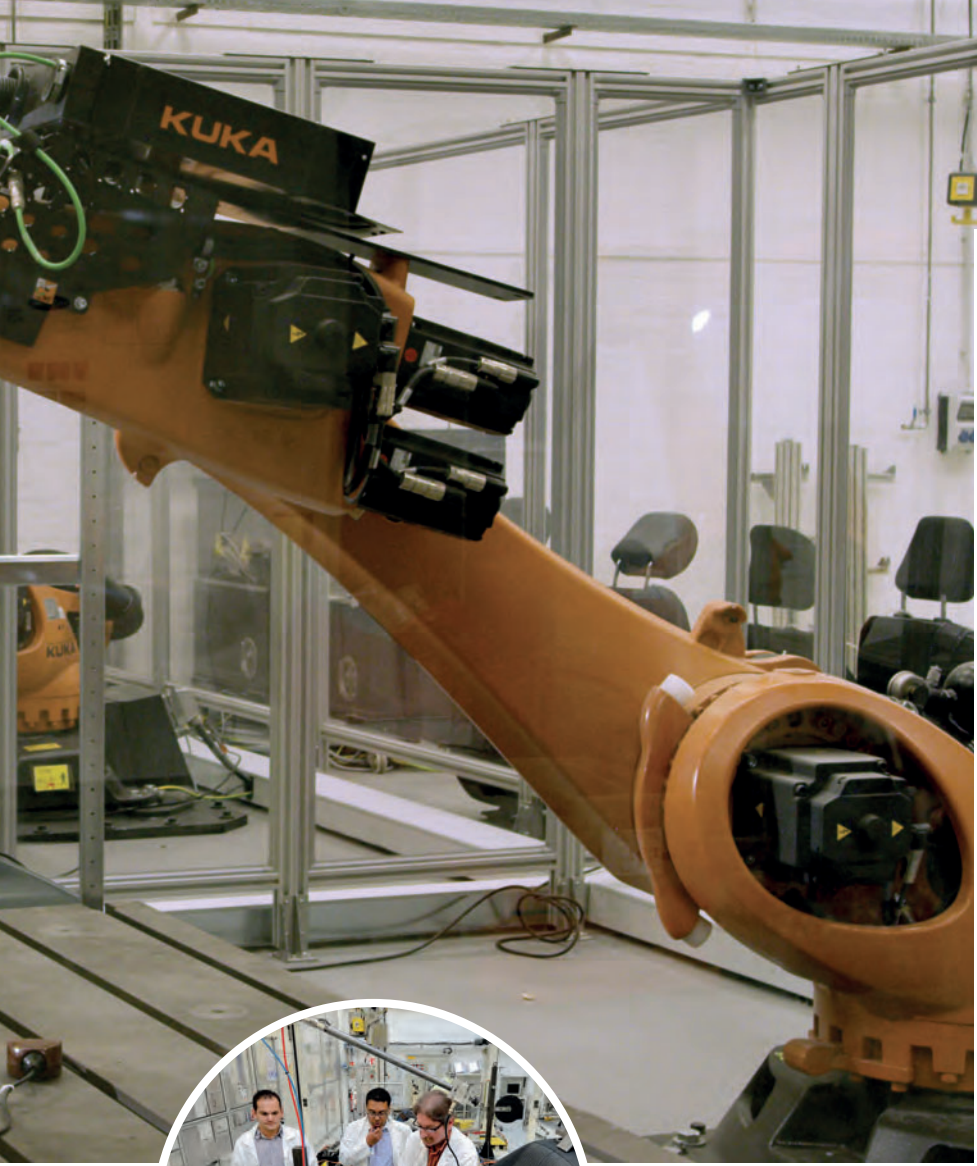


ABOVE: Ford uses a robotic butt form fitted with a water reservoir to analyze the effect of a sweaty bottom on a seat. Based on the dimensions of a large man, the robotic bottom is heated to 36°C, and soaked with about 450mm of water

LEFT: Pressure mapping is a common tool used by seat developers to supplement subjective analysis clinics

"We conduct extended dynamic ride evaluations for long periods to identify pain points and overall well-being"

Dino Nardicchio, global vice president for advanced technology engineering, Magna Seating



egress entry into the third rows of SUVs, to helping with cleanliness and organization.

"We conduct extended dynamic ride evaluations for long periods to identify pain points and overall well-being of people while using our product in a vehicle," says Nardicchio. "Fundamental to our design methodology is a seat design that properly supports the human being for proper posture and long-term comfort."

Magna has also done analysis in multiple clinics with sweating consumers when doing investigations on projects dealing with thermal comfort. Adds Nardicchio, "We also do tests with perspiring mannequins to simulate human beings sweating, but then always test with real people as well."

BACK TO BASICS

At Ford, a universal seat structure architecture incorporates lessons learned from previous programs, and underpins almost every Ford vehicle seat worldwide. Working from the platform as a base, model-specific features are developed targeting various demographics and needs. One pivotal theme of seat R&D for the company is health and well-being and, as part of this, for more than a decade Ford has been engineering technologies to prevent and alleviate back pain.

Ford's global seat and restraints supervisor for comfort, Dr Michael Kolich, notes, "It's clear that back pain is a common affliction. All over the world people experience it – those who drive for a living or have other jobs in which they sit down all day. And it's clear that concern for health and well-being is not a fad; it's a trend."

Backward approach

According to automotive seating technology specialist Faurecia's vice president of engineering, Dirk Brassat, although most seat development programs proceed without difficulties, sometimes new ways of thinking are required to overcome unexpected issues. "For example, applying a piece of equipment in a different way from how it's normally used," Brassat says.

Simulating a failure mode discovered during the final validation stages can also be a challenge, as Brassat explains, "It might be a noise or a crack that has arisen during one of the OEM's test profiles, for example. In such a situation you are not completely aware of the parameters, so you have to use your knowledge of physics and about how things are loaded, and do experimental testing to reproduce the failure. Then you can work on a solution."

LEFT: In addition to a standard suite of comfort, durability and safety testing, Faurecia is also developing solutions targeted at improving health and well-being as part of its 'Active wellness' seating technology concept

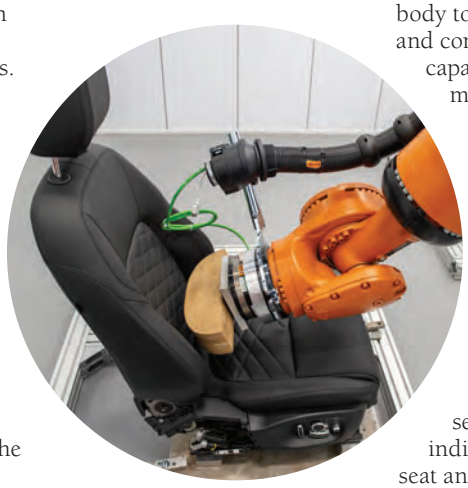
A recent example of how such work is being applied is in the new Focus seat, which received approval from German spinal health organization Aktion Gesunder Rücken (Campaign for Healthier Backs). Assessed by an independent test committee of experts from various medical fields, only seats that can be adapted to suit the occupant gain approval. The Focus seat achieves this by being adjustable in 18 different ways.

Ford in Europe ran track tests with male and female drivers of different heights, weights and body shapes to develop the optimum seat design. Durability analysis involved over 90,000 miles (145,000km) of real-world driving and use of the OEM's Robutt robotic bottom simulator, which condenses 10 years of use into three days as it sits, bounces and twists in the seat 7,500 times.

"Along the path, our research has involved many focus groups and work with medical professionals – both internal and external – who act as advisory people and shape our solutions for back pain prevention. We also work with companies in the supply chain who have expertise in this space," Kolich notes.

More generally, to inform and shape the design of its seats, Ford conducts research clinics with customers from all over the world, which to date have involved almost 10,000 individuals testing its seats.

"Internally we have people who represent the extremes of the population, but when we use customers, we usually do it in two ways. We do events with a random sample of people to confirm a solution before the product goes to market, and we hold research clinics specific to programs in which we target people that we think are going to purchase the vehicle."



ABOVE AND BELOW: At its facility in Leyland, UK, Millbrook uses a variety of data acquisition packages all integrated into one lab management solution. Test procedures are generally provided by the OEMs and incorporate learnings from R&D and real applications

SIT FOR PURPOSE

To improve the efficiency and effectiveness of its seat testing, Millbrook recently acquired a suite of new equipment for its test lab at its Leyland site in the UK. Thanks to the upgrades, engineers can now evaluate 25 seats simultaneously, using a combination of pneumatic test rigs, and single- and multi-axis vibration test benches.

Additional robots have doubled the capacity for simulating the motions and loads of a human body to analyze seats for wear and tear, durability and comfort. New pressure and temperature mapping capabilities expand the range of tests possible for measuring comfort and performance.

The two new Kuka KR 210 R2700 Prime Occubots are similar to industrial robots, Millbrook's chief engineer from the Leyland facility, Kevin Gough, explains: "Creating the Occubot required the addition of a multi-axial torque and force transducer, a bespoke control system and an SAE specification occuform."

According to Gough, the robots can replicate most individuals. "The initial step prior to creating the robot load path on the seat being tested is to make measurements of individuals getting into a vehicle, settling into the seat and then getting out of the vehicle," he says. "This is done using a pressure mat that provides data, which can then be used by the engineer to develop the program that drives the robot. We can then reproduce the profile of anyone getting into and out of the seat."

Each robot control system has an integrated data acquisition system, which continuously records the robot's position (x, y and z coordinates) as well as the load and moment applied. This can be interrogated at any time to identify if the response of the system on test has changed.

As an independent test service provider, Millbrook develops its own testing procedures. "These have been correlated against vehicle manufacturers' data to show that problems experienced in service can be replicated and subsequent product improvements verified," Gough concludes. ❮

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