

## Oh, snap! These new fasteners are smart

Australian architect develops high-tech bolts and latches, which can be operated without being touched

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Nuts and bolts, rivets, welding seams, glue and all the other fasteners that hold the artificial world together always have been as dumb as, well, nails.

Until now.

Avant-garde thinkers from Australia who last year moved to Chicago have devised whole families of intelligent fasteners smart enough to foretell a day when hammers, screwdrivers and wrenches will go the way of buggy whips. BlackBerries and laptop computers may be the only tools needed to put together and take apart just about everything.

"When I saw it introduced, I just looked and wondered 'Why didn't I think of that?'" said Kirby Harrison, a senior editor at Aviation International News, who attended the debut of intelligent fasteners at a trade show in Hamburg, Germany, last year.

What Harrison saw was a few buttons pushed on a remote control that caused the release of all fasteners holding airplane seats in place. This enabled workers to reconfigure the mock-up interior in a matter of minutes.

"Normally, you'd have mechanics crawling around with screwdrivers and wrenches to release the seats," Harrison said. "It'd take hours."

Giving intelligence to bolts and latches wouldn't occur to most people, but an odd set of circumstances set the mind of Dickery Rudduck moving in that direction some 15 years ago.

Rudduck, an Australian architect, was disturbed when his daughter, who was hospitalized, suffered a serious infection apparently from her intravenous feeding apparatus.

"I wondered why it was designed with a valve that required someone touch it, risking the spread of infection," Rudduck. "Why couldn't that be done remotely?"

He even invented a word--telezygology--to refer to controlling fasteners at a distance. Taking advantage of declining costs for electronics chips and proliferating new radio technologies, Rudduck started fiddling with fasteners that could lock themselves into place, activated by radio signals sent from a hand-held computer.

What Rudduck developed are fasteners analogous to locks in doors, only in this case messages are sent electronically to engage the parts to lock or unlock. A quick electrical charge triggered remotely by a device or computer may move the part to lock, while another jolt disengages the unit.

Instead of nuts and bolts to hold two things together, these fasteners use hooks, latches and so-called smart materials that can change shape on command.

The first commercial applications are intended for aircraft, allowing crews to quickly reshape interiors to maximize payload space. For long flights, the plane may need more high-cost business-class seats, while shorter hauls prefer a more abundant supply of coach seats.

A potential security breach threat apparently doesn't exist.

"I wondered what's to prevent some nut using a garage door opener from pushing the right buttons to make your airplane fall apart," said Harrison. "But everything is locked down with codes, and the radio signals are scrambled, so this is fully secured against hackers."

Eventually, Rudduck hopes that intelligent fasteners will find their way into almost everything. In addition to making things like airplane maintenance more efficient, the technology could solve some unique security problems and enable lower-cost designs. For instance, they should lead to products that no longer have visible screws and enable designs unconcerned about the need to get at some part with a screwdriver or wrench.

"It gives designers a free hand," he said. "With intelligent fasteners, they no longer have to worry about providing a tool path when they design a product."

By equipping intelligent fasteners with sensors that detect temperature, stress and other environmental attributes, inanimate objects will obtain the sort of self-awareness that is common in nature, said Bernard Perrine, chief executive of Telezygology Inc.

Perrine, who left Microsoft Corp. to join Telezygology, said intelligent fasteners will cut the costs of designing, building and maintaining products that use them, and this is just the first step in a new direction.

"This is Stone Age technology," he said. "This will progress along with nanotechnology and self-assembly into something more sophisticated."

Linking machines together in networks that enable them to talk to each other while only occasionally communicating with humans is becoming common and is called M2M, for machine-to-machine networking. Intelligent fasteners fit squarely into this world, said Steve Pazol, president of nPhase, a Chicago-based M2M software company.

"This isn't so different from RFID technology, where you use radio signals from tags on products to keep track of their movement," Pazol said. "I can see a lot of possible applications for smart fasteners."

Rudduck and his colleagues moved their company from Sydney to Chicago because Australia is far off the beaten path for the global fastener industry. They licensed their designs to Textron Fastening Systems Inc., a Troy, Mich., firm that is a leader in fastener technology.

Textron has launched some products aimed at the airline industry and has others intended for the auto industry.

The mechanism that holds auto airbags in place is a natural for intelligent fasteners, said Steve Brown, product development director at Textron.

Installing airbags with conventional screws is tedious and expensive, and it doesn't provide security. An estimated 50,000 airbags are stolen each year for resale, he said.

Intelligent fasteners only respond to radio signals that use appropriate codes. This would prevent removal of airbags by unauthorized people, Brown said. In cars, airplanes and other applications, a system of smart, networked fasteners provide a ready-made electronic maintenance record, he said.

"These products promote themselves," said Brown. Textron this year will supply evaluation kits of smart fasteners for engineers and designers to play with.

"It's like a fastener Erector set," he said. "You can use all the words you want in just talking about this, but when an engineer has it in his hands and sees what it does, he really lights up. That's when the innovation starts to flow."

The notion of adding intelligence to fasteners wasn't on Textron's agenda until the folks from Telezygology showed up.

"They came to us," said Seshu Seshasai, Textron executive vice president for technology. "We didn't go looking for this."

Seshasai said that plain old dumb fasteners still have a long life ahead of them, but as product developers learn what smart fasteners have to offer, they'll design products that will rise to a higher level of innovation.

"I've heard a lot of people who see this say, 'It's about time,' because these things open so many new possibilities," Brown said.

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