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## Thinking Outside The Cube

### The record for world's largest Rubik's Cube-style puzzle goes to an IEEE member

By SUSAN KARLIN 16 April 2012



When the Rubik's Cube craze erupted in 1980, most people wanted to solve it. IEEE Member Oskar van Deventer wanted to know how it was put together. The 3-D mechanical puzzle consists of six large outer sides built of layers of 3x3 matrices of smaller cubes, each consisting of one of six colors. Each layer can be turned independently of the others. The puzzle is "solved" when each layer is manipulated so each large outer side is returned to a solid color.

Photo: Jose Remmerswaal

By the ripe old age of 12, and before the Rubik's Cube hit the headlines,

van Deventer was already trying to teach himself how to design 3-D mechanical puzzles, after stumbling upon a book, *Creative Puzzles of the World*. So when the Rubik's Cubes were delivered in limited quantities across Europe, he cycled 20 kilometers to an Amsterdam toy store—twice—once to order one and then to pick it up.

He never outgrew its allure. Today, at 46, he's the Guinness world record holder for designing the world's largest Rubik's Cube-style puzzle, called *Over the Top*—17x17x17 surface squares (and 15.2 centimeters on an outer side), as opposed to the original's 3x3x3 squares (with an outer dimension of 5.7 cm). Getting it that big took more than simply making all the parts larger. He reconfigured the size and shapes of the internal blocks and mechanisms to turn in different directions, including its trademark spiral twist, without the cube falling apart. It took van Deventer several weekends over a year's time to design 14 virtual prototypes, and build three real-life ones. The final model took 15 hours to sort, dye, and assemble, ultimately requiring 1539 pieces. When he unveiled it last year at the annual American International Toy Fair in New York City, he knew he'd struck a chord. Guinness notified him a few months ago that he'd earned the record.

"I knew I had done something special, but the reaction I got from people was great, wanting to touch it or turn it," says van Deventer, a senior scientist at TNO, a research institute in Delft, the Netherlands. "A puzzle enthusiast friend said, 'Get used to it, you're now a puzzle rock star!' It's very stimulating that there are people who really like what I do."

## THE MAKING OF A CUBE

In 1974, [Ernő Rubik](http://www.google.com/url?sa=t&rct=j&q=erno%20rubik&source=web&cd=1&ved=0CC8QFjAA&url=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FEn%C5%91_Rubik&ei=nQNqT4v4EYWviAKK6PC0BA&usq=AFQjCNFuth4xOGAEVMIAj7DRMYjj0dN41w&sig2=ePX7rxI4_7G2f-o2aKdm4w) ([http://www.google.com/url?sa=t&rct=j&q=erno%20rubik&source=web&cd=1&ved=0CC8QFjAA&url=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FEn%C5%91\\_Rubik&ei=nQNqT4v4EYWviAKK6PC0BA&usq=AFQjCNFuth4xOGAEVMIAj7DRMYjj0dN41w&sig2=ePX7rxI4\\_7G2f-o2aKdm4w](http://www.google.com/url?sa=t&rct=j&q=erno%20rubik&source=web&cd=1&ved=0CC8QFjAA&url=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FEn%C5%91_Rubik&ei=nQNqT4v4EYWviAKK6PC0BA&usq=AFQjCNFuth4xOGAEVMIAj7DRMYjj0dN41w&sig2=ePX7rxI4_7G2f-o2aKdm4w)), a Hungarian sculptor and architecture professor, invented the mechanism that made the Rubik's Cube possible. The item is still among the world's top-selling toys. The mechanism's magic was its ability to turn and rotate its layers of cubes in different directions without falling apart, a system that required four different internal devices that connected to one another.

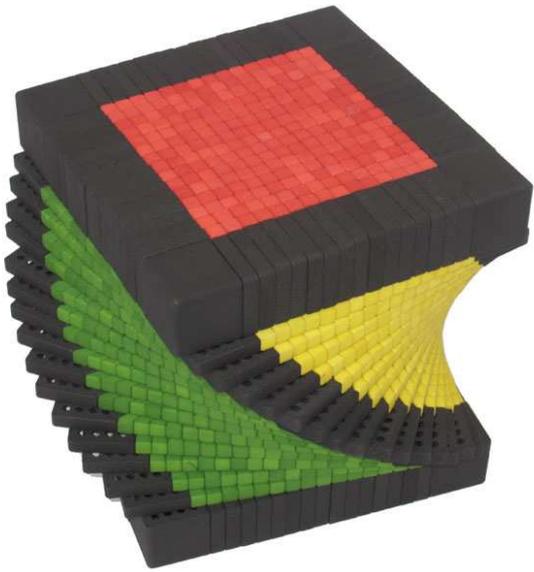
"He's designed other things, but there was something about the Rubik's Cube that's captured the fascination of the puzzle world," van Deventer says of Rubik. Other people came up with larger versions—4x4 and 5x5 in the 1980s, for example. In 2003, Greek inventor Panagiotis Verdes patented a design for cubes as large as 11x11x11. "His patent implied that this particular mechanism was limited to 11," van Deventer says. "It made me decide to go higher."

Van Deventer started with the original Rubik's Cube dimensions, and through a series of calculations, realized how he'd be able to expand the number of cubelets comprising each side by two at a time. He settled on 17 because "it was a ridiculously high number," he says.

"If you know how to solve a 5x5x5 puzzle," he adds, "then you have the tools to solve one that's 17x17x17. It's not more complicated, just more work."

Easier said than done. Van Deventer's first prototype, completed in April 2010 with the help of US \$2000 from a friend for 3-D printing of the prototype, was "a miserable failure!" he says, laughing. "The parts jammed, and the pieces fell out." So van Deventer lengthened and slimmed down the internal connective parts to reduce friction and stabilize the building blocks, or "tiles," that make up the puzzle. Tiles of various shapes enable the cube's spiral motion when it's turned. "Every time you go up in size, you have to redesign the shape of the tiles," he says.

A second prototype later that year showed progress. In December, van Deventer finally nailed it with his third—sponsored by 3-D printer [Shapeways](http://www.shapeways.com/) (<http://www.shapeways.com/>) of New York City—which he showed off at the New York Puzzle Party Symposium during the Toy Fair in February 2011. After submitting documentation of his invention to Guinness, the company sent him his world record certificate several months later for the "Largest Order



*IEEE Member Oskar van Deventer's record-breaking cube.*

Photo: Jose Remmerswaal

Although he gravitates toward puzzle mechanics, van Deventer focused on all things electrical in college. He earned bachelor's, master's, and Ph.D. degrees in EE from Eindhoven University of Technology in the Netherlands. His master's work focused on satellite communications and aiming antennas, and his Ph.D. on optical fiber networking. Upon graduating in 1987, he became a research engineer at the Dutch Post Telephone and Telegraph Service in Leidschendam. In 2003, he landed at TNO, which aims to bring academic research to commercial innovation. Van Deventer is a member of the [IEEE Communications Society](http://www.comsoc.org/) (<http://www.comsoc.org/>).

Actually, his EE experience helps with some of his puzzles, like his [Four Bit Maze](http://www.youtube.com/watch?v=6HKQTuVD2ac) (<http://www.youtube.com/watch?v=6HKQTuVD2ac>), a programmable electronic mechanical puzzle. He is still designing other puzzles, which he unveils on [YouTube](http://www.youtube.com/user/OskarPuzzle) (<http://www.youtube.com/user/OskarPuzzle>), [Shapeways](http://www.shapeways.com/shops/oskarpuzzles) (<http://www.shapeways.com/shops/oskarpuzzles>), and Clickmazes. Some of his puzzles appear in the Ubisoft video game [James Noir's Hollywood Crimes](http://www.youtube.com/watch?v=9k0U-ty9bgs) (<http://www.youtube.com/watch?v=9k0U-ty9bgs>). Players are required to solve the puzzles in order to advance in the game.

"As far as world records, the Rubik's Cube was the one that had to be broken," he says. "Although I hold an unofficial record for the highest order mechanism, for a 2x2x23 puzzle, that was just extending its dimensions beyond absurdity, just to see how far I could go. A mechanical puzzle is, most of all, a demonstration of a mechanism—how the gears and chains mesh in one way and not another."

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Rubik's/Magic Cube."

His cube would not have been possible without 3-D modeling, computer-aided design software, and 3-D printing. Prior to 2003, he designed on paper and crafted prototypes by cutting plastic, wood, and metal. But by using 3-D software, he could simulate designs and troubleshoot potential problems as their components were moved virtually.

## **ELECTRICAL BEGINNINGS**

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