Companies & Strategies

How to Build A Mountain

Joann Muller, 10.27.03

Disney's 4-D technology aims to take the adventure out of building roller coasters.

Get this: In the middle of sun-drenched Orlando, Fla. the Walt Disney Co. is erecting a 60-meter-high replica of snow-covered Mount Everest. It's a showcase attraction scheduled to open in 2006 at Disney's Animal Kingdom theme park. The premise: Visitors board an old mountain railway headed to the foot of Mount Everest. As the train climbs higher into "the Himalayas," it passes thick bamboo forests, thundering waterfalls and shimmering glacier fields. But the track ends unexpectedly in a gnarled mass of twisted metal. Suddenly the train begins racing forward and backward through caverns and icy canyons until riders come face to face with a giant hairy creature--the mythical yeti.

It's enough to scare the wits out of Don W. Goodman, who has the job of ensuring that the $100 million roller coaster is finished on time--and on budget. It is a logistical nightmare: Hundreds of workers from independent contractors must simultaneously build the roller coaster and the mountain that contains it. They will erect 1,200 tons of steel and install one and a half hectares of rockwork.

Goodman, president of Disney's Imagineering research lab, compares it to assembling a 3-D puzzle. It is difficult to anticipate the conflicts that will arise, say, between workers installing faux rock formations and crane operators erecting steel tracks. Each snafu can add cost and delay. But the challenge will be made easier, Goodman says, by new software, developed in-house, that lets architects, engineers and contractors peer into the future.

By marrying an architect's 3-D computer-aided design images with planning software that tracks construction schedules in real time, Disney can create a virtual "movie" of the Expedition Everest project. This 4-D software--the fourth dimension being time--breaks down a 3-D image of a project into millions of pieces of data and then reassembles it step-by-step, in the sequence in which the structure will be built, to visualize how it will all come together.

Better yet, Disney's theme-park software can be used to map out almost any construction project--amusement park, office building or even an underwater pipeline. That is why Disney, uncharacteristically, has formed an independent company, Common Point, to sell the software to other companies. (So far it's had $500,000 in sales.) Disney spent $1 million creating the software and gets to use it free, with the promise of a special price on future versions. But the real point, Goodman says, is to seed the construction industry with the software so that more vendors will use it, reducing Disney's own development costs.

"Problems you find together, you tend to solve together," says Imagineering's chief scientist, Benedict Schwegler, who championed the use of 4-D tools inside Disney.

Changes and glitches can add 25% to the cost of a troubled construction project. "If we could get that to under 10%, that would be a huge savings," Goodman says--$3 million or more on a big project like Expedition Everest. The savings help at a time when Disney's theme parks have endured a 22% decline in operating income this year (to $732 million), on top of a 26% drop in 2002.

Disney first used its special 4-D software to build California Screamin', a $50 million roller coaster at Disney's California Adventure theme park in Anaheim, California. It worked so well that engineers went on to use the software for the park's entire Paradise Pier section, which features rides, restaurants, shops and a boardwalk. Paradise Pier had 10% to 20% fewer design changes as a result.

In Hong Kong the 4-D technology is being used to build Space Mountain at the new Disneyland theme park, set to open by early 2006. And the software has been especially useful in Disney's most vexing project: the reconstruction of the 26-year-old Space Mountain at the original Disneyland in Anaheim. Among the hassles: Contractors must remove a giant crane from the temporarily closed ride by 2 p.m. every day to make way for the Mickey Mouse parade. And materials must

be lifted through a hole in the mountain that is 9 meters above ground. Goodman likens it to building a ship in a bottle. When contractors previewed the project in 4-D, they spotted a flaw: Had they started to build the steel structure where they had originally intended, they would have had to halt construction for two months while they reinforced the site. Instead, they began laying the steel at another site inside the mountain while they prepared the first site. By doing this, they kept the renovation on track for a 2005 reopening.

Disney's software also helped plan construction of the stunningly complex Walt Disney Concert Hall in downtown Los Angeles. Renowned architect Frank Gehry designed it in 3-D, but it was up to the general contractor, M.A. Mortenson Co. of Minneapolis, to figure out how to build it. Greg K. Knutson, Mortenson's general superintendent, says subcontractors had difficulty grasping the task ahead of them until he showed it to them using Disney's 4-D software. Then, he says, "the lightbulb went on."

A handful of big contractors are using the software, dubbed Common Point 4D, to sketch out the construction or renovation process for major hospitals, shopping malls and Miami's port. Some major corporations also are intrigued. Genentech used it for portions of its Founders Research Center in San Francisco, one of the world's largest biotech labs. Developers have used it to plan a 965-kilometer Shell pipeline off the coast of Russia. And workers are being trained virtually to work on ExxonMobil offshore oil rigs that haven't even been built yet.

California's DPR Construction is one of the early believers. For a San Francisco-area shopping mall, DPRused the software to plan difficult logistical challenges such as getting concrete up five floors inside tight quarters. In the end, DPRsays 4D helped it shave three weeks off the mall's one-year construction schedule, ensuring that it would be open by Christmas. At a Phoenix hospital where DPR is building a new wing, 4D alerted contractors to a problem you don't want to spot late:The mast of their giant crane would interfere with the flight path of the hospital's medical evacuation helicopter. Alerted early, the hospital filed a revised flight plan with the Federal Aviation Administration. "We solved that problem before it became a problem," says Dean Reed, DPR's production planning manager.

Disney may be the surprise winner over the handful of other software companies that have created 4-D tools, like Bentley Systems and Intergraph. What sets Disney's technology apart from those proprietary tools, says Schwegler, is that "it's agnostic." It doesn't matter which 3-D computer language was used to design a project--they all blend easily into Disney's 4-D scheduling soup.

That was Schwegler's objective back in 1998, when he set out to use 4-D technology on California Screamin'. He contacted Stanford professor Martin Fischer, a leading researcher in the field of 4-D, who assigned a Ph.D. student, Kathleen Liston, to help Disney out. Schwegler and Liston quickly concluded that commercially available software wouldn't suit Disney's needs; they would have to develop their own, with Disney footing the bill.

After $1 million and three and a half years of development, the tool was ready. By then Liston was advocating a break from Disney. In March 2002 she and Fischer negotiated with Disney to spin off the software into a new company, Common Point, with Liston as chief executive and owner of a majority stake. Fischer owned the rest. The plan was that if the business thrived after 18 months, Disney would get a tidy payout. Instead, Disney and Common Point are negotiating to restructure the deal in a way that will likely extend Disney's rights to the free software. Liston's original stake, meanwhile, has shrunk considerably. She recently merged Common Point with another startup and also sold an undisclosed equity stake to a large contractor that uses the software.

No one can lay claim to the idea of 4-D visualization, says Stanford's Fischer. After all, it's what most of us do in our heads every day. "The nice thing," he says, "is that it makes sure that what's inside your head looks the same as what's inside my head." Without that kind of collaboration, a construction project can get really scary.