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How Technologies Both Old and New Can Help Rebuild the Fire-Ravaged Notre Dame

Conservation experts warn against a speedy reconstruction.

Naomi Rea, April 18, 2019

Notre Dame Cathedral, as seen in the videogame *Assassin's Creed Unity*. Image courtesy Ubisoft.

After Monday night's devastating fire at Notre Dame, French President Emmanuel Macron pledged that the marvel of gothic architecture would be rebuilt within five years—and that the restored cathedral would be "even more beautiful than before."

As conservation experts and architects in France and around the world assess the challenge, they are looking to technology, both old and new, to complete the epic task.

Before anything else, a detailed survey of the damage must be conducted, explains Alixe Bovey, the head of research at London's Courtauld Institute of Art and an advisor to the Canterbury Cathedral, one of the oldest and most celebrated gothic structures in the UK. Scaffolding will need to be erected around the entire structure, and it will be important to consolidate the walls, as the heat of flame can weaken the load-bearing capacity of the limestone.

Bovey is relieved that the fire, which looked terrible from the images that circulated on Monday, was not as devastating as had initially been feared. "It really is a tribute to medieval engineering and the very intelligent way the fire service fought the flames," she says, adding that it was good they didn't "water-bomb" it, as US President Donald Trump suggested on Twitter. (The water could have decimated the structure of the building.)

Notre-Dame Cathedral at sunrise following a major fire on Monday. Photo by Dan Kitwood/Getty Images.

Bovey was, like many experts, shocked to hear Macron's pledge to complete the reconstruction work by 2024, although she says it is not impossible. "He presumably has a level of information that few people have access to," she notes. "It's possible if the only significant building work they need to do is re-roof it." Nevertheless, she cautions, tasks such as the painstaking conservation of damaged stained glass could take a lot longer than five years to carry out.

“People like Heather Newton [Canterbury’s head of conservation], the kinds of people who’ve spent their lives caring for ancient churches, are the kinds of voices we need to be listening to rather than political voices that want to set fixed deadlines on things,” Bovey warns. “We need to be careful.”

She stresses that while innovative technologies can be a tremendous help, it is important not to get too carried away. “We need to think about what has enabled Notre Dame to survive this long, which is not technologies invented in the past five years that we don’t know will stand the test of time,” she cautions. “We know that a manuscript can last 10,000 years, but we don’t yet know that a digital image can survive 60 years.”

Can a Video Game Offer Answers?

In the wake of the disaster, there has been much talk about how digital technologies could aid the reconstruction effort. One unorthodox idea is that models made for the 2014 video game “Assassin’s Creed Unity,” which is set in Paris during the French Revolution, could prove useful to conservationists. The game’s artist Caroline Miousse spent more than a year making a detailed recreation of the cathedral.

Visitors stand at a booth for the computer game Assassins Creed Unity in 2014 in Paris. Photo by Stephane de Sakutin/AFP/Getty Images.

While this is an attractive proposal, experts are quick to dismiss it. The historian Maxime Durand, who worked on the game, told the Canadian paper *La Presse* that the designers had taken some “artistic liberties.” Cédric Gachaud, the head of Life3D, the company that modeled the cathedral for the renovation work that was underway at the time of the fire, added to *Le Monde* that while the game-makers

had done impressive work, a model based on photographs and maps was not accurate enough for the job at hand.

“They are looking for a coherent visual, and if a statue is two meters bigger than in reality, it’s not important for them,” he noted. “As for us, we are looking for millimetric precision, working with engineers and data analysts.”

But there are some high-tech tools that will be useful, experts say. Notre Dame, which welcomes some 12 million visitors a year, is one of the most photographed buildings in the world. Photography, especially high-resolution and drone images, will be vital. These can be used with artificially intelligent algorithms to create accurate maps and 3D models using photogrammetry.

Experts will also be looking to technology used by architects and engineers, such as laser scanners, to offer an even greater level of precision. They are expecting to rely in part on the work of the late American art historian Andrew Tallon, who, before his untimely death in 2018, helped create an impressive 3D model of the cathedral’s interior at Vassar College. To create the highly accurate spatial map, Tallon took detailed scans of the cathedral using 3D laser scanning technology that offers millimeter precision. He also mapped high-resolution panoramic photographs onto the 3D form created by the laser.

Remember: Old Tech Is Best

New technology will be helpful, no doubt—but architects and conservators say the backbone of the project will be supported by much more traditional tools. After all, it was medieval engineering that allowed Notre Dame to stand for 850 years.

John David, the master mason at York Minster, a cathedral in the North of England that has also suffered fire damage in the past, emphasizes that those in charge of the Notre Dame’s restoration should look to experts in medieval techniques, such as stonemasonry, carpentry, and stained glass.

“Whoever is in charge of restoration should not look at speed but should look at care,” he says. A high profile-building like Notre Dame will attract a lot of interest from people wanting to make their name or walk away with a profit, he warns. “These buildings are more important than that and there are opportunities to promote that the work can be done to a high quality,” he says. “It is best done by craftspeople who really care about what they’re doing, and they do exist.”

Flames and smoke billow around the gargoyles decorating the roof and sides of the Notre-Dame Cathedral in Paris on April 15, 2019. Photo by Thomas Sansom/AFP/Getty Images.

David says the reconstruction efforts present a “wonderful opportunity” for France to train more craftspeople in conservation work and offers the opportunity of a lifetime for students to learn on site. “It is a sad disaster, but also a challenge. The French authorities should take that on board, with considered, balanced, educated, and informed agreements and discussion,” he says.

Indeed, crucial mistakes have been made in the past when restorers used new materials without proper testing. The Courtauld’s Bovey points to the collapse of vaults in Italian churches that were hastened by the addition of concrete reinforcements in the 1960s. In 1997, the frescos in the Basilica of Saint Francis of Assisi were badly damaged when its roof collapsed in an earthquake.

One thing British conservation experts stress is the importance of building in preventative measures. “An ounce of prevention is worth a pound of cures,” Bovey says. This includes compartmentalizing the roof spaces and placing firewalls inside so that a fire won’t spread to another area.

The number of deep-pocketed donors who have pledged vast sums of money to the cause is striking, Bovey says—“but the tragedy of it really is that it takes a crisis like this for people to recognize the value of this fragile heritage and support it.”