



After the flood, digitalization

How a group of scholars is slowly putting valuable archives from Florence onto the Internet

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In the early morning of Nov. 4, 1966, while Florence slept, the Arno River, overwhelmed by unprecedented rains, suddenly overflowed its banks and unleashed a lethal mixture of water, mud and debris. The city never had a chance. Its narrow streets served as perfect conduits, leading the river into the heart of Florence.

At 9:45 a.m., a wall of water six metres high reached the Piazza del Duomo, home to the Cathedral of Santa Maria del Fiore, the city's most distinctive landmark. It forced its way through the bronze and golden doors of the Baptistery, tore off the marble lid of a Roman sarcophagus, and ripped through the cathedral's administrative archives, which date back to the 14th century. In all, some 6,000 volumes documenting the construction of the cathedral were submerged in mud, rendering large parts of them virtually illegible.

But that was then. Today an international team of scholars, aided by sophisticated imaging technology, is attempting to reclaim these documents and transmit their contents, for free, over the Internet in the form of a vast digital archive.

"These documents are part of a public cultural heritage, of our cultural commons, I would say," explains Jürgen Renn, the executive director of the Max Planck Institute for the History of Science in Berlin and a key collaborator in the effort. "Such floods are warnings to all of us to use all options for preservation that we can think of, and the digital medium is one of those."

Known as "The Years of the Cupola Project," it focuses on all 20,000 documents, covering 1417 to 1436, when the ingenious architect Filippo Brunelleschi planned and constructed the cathedral's famous cupola. Spanning 44 metres of empty air, this octagonal brick dome, ribbed by eight buttresses of marble, is a feat of engineering and artistry, and stands to this day as a symbol of Florence.

"Certainly it's the seminal piece of Renaissance architecture," says Daniel Schodek, a professor of architectural technology at Harvard's Design School. Soaring 90 metres above ground, it was at the time the largest dome in the world.

"It was a pivotal point in the development of architecture," Schodek adds. "But despite all this talk about the building for so many years, relatively little is known about it."

That may soon change. With about a third of the "Years of the Cupola" archive at their fingertips, scholars can now use this online tool to help reveal the human drama behind the building of Brunelleschi's masterpiece, as well as offer clues as to how it was actually constructed.

Much to the astonishment of his contemporaries, Brunelleschi built his cupola without a supporting framework of fixed scaffolding, which for a dome of such immensity was considered essential to keep the structure from collapsing.

"Since it more or less breaks the rules and conceives of a construction that is nowhere to be found in the Gothic era, it's been a mystery for some four, five hundred years," says Frank Toker, an art historian at the University of Pittsburgh. "So we're interested in the minutiae of this particular question."

According to Margaret Haines, the art historian who has been directing the "Years of the Cupola" project since its inception in 1994, all 20,000 documents, each painstakingly transcribed, edited and analyzed, will be online in about a year. So far, around 6,000 documents are already accessible via an elaborately cross-indexed browsing mechanism, with versions in both English and Italian.

"What we're doing is something very isolated and extraordinary, which is total documentation," explains Haines in her office in the cathedral archives on the Piazza del Duomo. "What we have offered is an experiment, in a sense, in the extreme, for a period which was judged to be worth the trouble."

Overseen by the Opera del Duomo, the administrative board that has been shepherding the cathedral since 1331, the Cupola project works in collaboration with a diverse set of academic and cultural institutions. Motivated by the

common desire to provide greater access to Europe's cultural inheritance, the team aims to restore disused manuscripts — not physically, for many are beyond repair — but in cyberspace.

Indeed, the view is far better this way. With assistance from the European Union's ECHO (European Cultural Heritage Online) Initiative, the site now features a prototype of a "virtual archive" displaying natural light photographs of the manuscripts in their current condition, some microfilm copies taken before the flood, and a series of technologically enhanced images of the flood-damaged manuscripts.

These low-intensity ultraviolet digital photographs, provided by the University of Applied Sciences in Cologne, Germany, can illuminate washed-out ink in remarkable detail, and thereby enable impossibly faded texts to become easy reading.

"We really want to exploit the full potential of the medium," says Jochen Büttner, a research scientist with the Max Planck Institute, who works on the programming and design of the online project. "The 'Years of the Cupola' can be seen as a proof of concept of how the potential of the new media can be utilized to create the counterpart to what traditionally would be a critical edition of a historical source."

Such an edition, customarily published in book form, does not exist, and if one were to try, the price would be prohibitive, the size unwieldy, and the ability to search the archives limited. There are, of course, a handful of scholarly texts that discuss several of the more eye-catching archival documents of this period, and their contents will undoubtedly, through the digital initiatives of Google or the Library of Congress, eventually make their way online.

But the "Years of the Cupola" provides something very different: It includes every single scrap of information available — from the acquisition of the flat, knifelike bricks called *quadroni* to the death of a worker who fell from the third tribune; from the wine served on feast days to the firing of an ox-handler for "unreasonably" refusing to lift loads up to the cupola at the offered rate of 13 denari.

"A great portion of the archives, about 90 per cent, are unpublished, and they give a vastly detailed cross-section of the time that can't be obtained otherwise," says Anna Mitrano, president of the Opera Council, through a translator. "It's directed to a quite specialized audience, but that person is there."

Much of the material is of interest primarily to historians of science, architecture, Renaissance art, ecclesiastical history or material culture. They also provide excellent training in Renaissance paleography — the art of reading old writing.

"That is, of course, what we do here," Haines says.

Take, for example, a document from 1417 in which the expenses of a messenger have been recorded. Haines finds it in a tall, narrow volume, about 30 by 10 centimetres, bound in parchment. At first glance, the bottom third of the page is largely blank, the faded brown ink more like a palimpsest than a readable text. But when Haines calls up the document on her computer and clicks on its digital image, the whole page pops out at us in a firm, confident script.

"We can zoom in on a part of it that we're particularly interested in. For example, this is his first name, Jacopo," Haines continues. "Isn't that a strange J? You can see how it's done. And that's 'allodola,' which means the swallow, and that was the nickname of this messenger."

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Such insights might seem small — even petty — to the layman. The cathedral's archives are largely administrative in nature and, as such, they divulge more than most of us would ever want to know about innumerable messengers, their names and expenses.

But in this wealth of data lies the archives' real power. Brunelleschi was protective of his ideas in a world without patents, one where competitors would — and did — steal his designs. As a result, he committed little to writing. With the pickings this slim, these archives take on renewed importance.

"We have many black holes," says Marco Berni, an architect with the Museum of the History of Science in Florence, who has designed 3-D models of Brunelleschi's innovative hoists and cranes. "There are very large wars between people who say it was built this way or that, but we are not able to really know how it was built."

What we do know is that Brunelleschi came up with a solution of his own devising. Although he had sworn to abide by the strictures of size and form decreed by the Opera board a century earlier, Brunelleschi was free to assert his genius in the realization of that form, and in so doing, created the first architectural "work of art" — a work propelled by the vision of one man. This, in essence, was the germ of Florentine humanism, the triumph of self-expression, of art over craft, of the individual over God — and the guild.

"Brunelleschi invented the person of the architect, the modern architect. He is an adventurer, he wanted the new," says the colourful Florentine architect Massimo Ricci, who has devoted 30 years to studying how the dome was constructed.

"The people use with him `bestia,' [which] in Fiorentino is `animale,' animal, because the method invented by him is so strange that for the people, he's crazy, he's impossible."

Brunelleschi's first major decision was to reject the idea of a supporting framework, or armature, as unworkable in such a large space. But this only led to a different set of problems. How, without this handy scaffolding, would the workmen haul the heavy chunks of stone to the heights of the ever-rising dome? How would they position them properly to maintain the cupola's curvature?

To solve this dilemma, Brunelleschi invented a series of ox-driven hoists and precision cranes, which managed to deftly manoeuvre enormous stone blocks to within inches of their desired placement.

But there were further difficulties. While classical domes were spherical, Brunelleschi was obliged to build his cupola in the form of an octagonal pointed arch, which is inherently less stable. To help counteract this, he inscribed within this unorthodox shape a series of concentric rings that lock the masonry in place.

"I think Brunelleschi's most brilliant intellectual achievement was that he conceived of the circle lying inherent in his octagon," says Toker. "He conceived the curvature to be self-supporting."

As its maker, Brunelleschi's mark on the cupola is omnipresent. In recognition of his contribution to Florence, Brunelleschi was buried inside the Duomo itself — a great honour, granted previously only to St. Zenobius. But it might not have ended this way.

In fact, Brunelleschi had a rival: the sculptor Lorenzo Ghiberti, who, at the behest of the Opera, was granted the title of *co-provveditore*, or co-administrator, alongside Brunelleschi.

"Ghiberti was with him for 16 years of building the cupola — a thorn in his side," says Haines. "But this is the way of involving the competition and getting consensus; it's the idea of getting the whole populace behind the idea."

While Ghiberti's presence placated the powerful constituency of wool merchants who backed him, he had little to contribute to the actual construction of the dome. As the archives reveal, in 1423 his salary remained frozen at 36 florins, while Brunelleschi's almost tripled.

Brunelleschi had prevailed, but not without some cost to his pride. Difficult, crafty and egotistical, he tended to outrage and provoke, and was embroiled in controversy throughout much of the cupola's planning and construction. The Opera documents tell the juicy tale of the time he was arrested and put in prison for refusing to pay dues to the Guild of Stonemasons and Carpenters.

Of course, Brunelleschi, who instead was enrolled in the silk guild, was immediately released. In retaliation, the Opera decided to arrest one of the consuls of the masons guild and put him behind bars, "so that the office [of the Opera] be not made fun of," a document, dated Aug. 20, 1434, reveals.

Such fiery scenes are rare in the Opera archives. Nevertheless, to the patient but dogged scholar, these records are a gold mine. One curious document, which has slipped through scholarly cracks through the years, is making its debut on the "Years of the Cupola" website. Dated March 14, 1430, it records the "payment for purchase of tacks and iron wire" for the tribune *stella*.

At first glance, this sounds frightfully mundane. But one of the key challenges in constructing the cupola was how to maintain its proper curvature without an internal scaffolding. Some scholars have hypothesized that, to keep the curvature consistent, Brunelleschi used a system of cords or wires of varying length, which may have crossed in the center to form the pattern of a *stella*, or star.

"This is an interesting term which is fairly rare in the documents," notes Haines. "A sensitive researcher looking into the means of building a four-fifths [pointed] arch up into the empty air might have a very creative idea of what might be done with this."

Other scholars see the value of the archives differently. "I don't know how much more these archives will tell us about the way it was constructed," says David Friedman, an associate professor of the history of architecture at the Massachusetts Institute of Technology. "What they will tell us is information about projects that people haven't even been able to imagine yet, or have only imagined but have not been able to research."

But this, in the end, is the essence of scholarship: the slow accumulation of details, which grow to reveal the shape of something heretofore unknown. In fact, the inherent value of the archive may lie not in the individual documents

themselves but in the patterns that emerge when they are considered as a whole.

"Basically, we will have to see what future scholars do with this kind of total documentation, and the extent to which it makes it possible to change the sort of questions one asks and the way one tries to solve them," says Haines.

"This will just have to be our legacy to another generation, in a sense. It's like having a child or something — you have no control over what he's going to do with the genes you gave him. We'll just see where it goes."

The "Years of the Cupola Project" is accessible at http://www.operaduomo.firenze.it/cupola/home_eng.html. Jenny Attiyeh hosts ThoughtCast, a podcast and public radio interview program on authors, academics and intellectuals. She lives in Boston and can be reached at jenny@thoughtcast.org.

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