

# The Persistence of Memory

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**NORMANDY DOES NOT** let go of summer easily. There is a soft wind that rises from the channel and cooling rains that temper the sun, allowing the rich colors of the grass, hedges, and flowers to linger upon the rolling hills. It comes as no surprise, therefore, that the Celts, the Romans, and then the Vikings chose this place as home. Such is the energy of this region that it was also witness to the Battle of Hastings (which redefined the cultural landscape on both sides of the Channel) as well as the devastation of World War II (which resulted from the fierce advance of the Allies in conflict with the Axis). It is therefore also remarkable, with such tumultuous history, that there remains significant material evidence of these past cultures. Mont Saint-Michel is one such ancient artifact: a monastery dating from the 8th century, it was central to both the spiritual and political life of a vast swath of western France.

## Architecture

A study of the history of civil architecture reveals many such significant structures: the Taj Mahal in Agra, St. Basil's Cathedral in Moscow, the Pyramids of Giza in Egypt, Machu Picchu in Peru, Fallingwater in Pennsylvania, Petra in Jordan, Chichen Itza in Mexico, the Sydney Opera House in Australia, the Forbidden City in Beijing, the Millau Bridge in France, the Prophet's Mosque in Medina, and the Empire State Building in New York. The list goes on, and continues to grow as each generation incrementally places its mark on the landscape.

As any student of architecture will tell you, these artifacts are not just things but possess deep meaning according to the set of concerns that frame a person's worldview. To the engineer, a study of such buildings has meaning—and might lead to new insights for contemporary structures—because it exposes the differ-

ent ways you can apply different materials to yield structures that are not only functional but also beautiful. To the engineer, a study of such buildings is also a study in the evolution of best practices—practices that have accumulated over centuries of trial and error and that have been supported and advanced by hard science. The Bent Pyramid in Dahshur is a very visible manifestation of the concept of an angle of repose: a critical angle exists beyond which components stacked on one another become unstable.

## Anthropology

To the cultural anthropologist, a study of such artifacts has meaning because they tell us much about what each particular culture valued. Many of the structures I've named not only had important cultural significance to the peoples surrounding them but also were often fundamental to that region's economics. The Great Pyramids in Egypt, for ex-

ample, were not only a visible manifestation of spiritual practice. The process of building them required marshaling significant resources that shaped—and in some cases ruined—the governments that commissioned them and the natural landscape around them from which the raw materials were drawn.

To the average citizen of their time, each of these artifacts was quite pragmatic. The Empire State Building, opened in 1931 in the midst of the Great Depression, was not only a hopeful symbol of the growing power of New York City but also a place where captains of industry could wield their power and their many minions would carry out their orders. Machu Picchu's purpose is still not clear, but what is clear from its scope is that it was important in its time for the life of a vibrant community.

Some buildings survive, some do not. History is certainly selective because we know of and can study only those that did survive. The Hanging Gardens of Babylon, the Tower of Babel, and the more recent destruction of the Tomb of Jonah by ISIS: these are all artifacts now lost to time and held only in our memories.

Speaking of time, the Clock of the Long Now comes to mind. Here we have an effort envisioned by Danny Hillis—a computer scientist who designed the Connection Machine—to build a human artifact that will last for 10,000 years. Will it last that long? Only time will tell. What does it tell us about us that some seek to even build such an artifact? You'd have to ask Danny himself, but my take is that its meaning lies in our human longing to demonstrate the timeless of us, especially in the face of an increasingly disposable and time-challenged digital life.

### Patterns

If you step back and observe the collection of civil architecture across time, patterns emerge. We can name architectural styles such as Grecian, Victorian, Gothic, Neoclassical, Islamic, Spanish Renaissance, Minka, American Colonial, Moorish Revival, and Bauhaus. The list goes on. The fascinating thing about these many styles is that they not only reflect the context in which they were created but also define their cultural context. In a real sense, we see this exquisite coevolution of artifact and culture, a dance in which the culture shapes its artifacts and the artifacts shape the culture. Naming these styles gives us some sense as to the styles and patterns that shape us as humans.

This naturally leads us to Christopher Alexander, author of *The Timeless Way of Building*. Alexander's seminal ideas center on the fundamental patterns that yield useful structures that are also beautiful and elegant, that possess "the quality

very fundamental ways. Patterns not only shape our civil architectures; they shape our software-intensive ones as well.

Each generation remakes itself. In the context of the historical, economic, technological, and cultural forces around it, each generation must confront, adapt, and evolve—or die; this is the nature of humankind. Christopher's ideas illustrate that common threads exist that shape this evolution, threads that also define our humanity. Even in the face of the tumultuous changes brought about by computing, these threads persist, and bring a poignant texture to a fully digital life.

### Background Noise

However, today, for the average person simply trying to get along in life, we look at these ancient civil artifacts and are largely unchanged. They represent shadows of the past; they do not materially change the way we go through our day. We might look up at them from



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that has no name." Alexander's ideas were brought over to the software engineering community and took root in the work of Richard Gabriel, Kent Beck, Ward Cunningham, the Gang of Four, myself, and many others. What's significant to me about Christopher's work is that it speaks to the digital threads that transcend time, that shape what we do in some

time to time and feel a sense of awe and wonder and beauty, but then we look down to our smartphones and move on. These older, quite significant symbols of our selves are so much a part of our cultural selves that they are now invisible; they have become part of the noise of daily life. In our cities today, even, there are legions of people who make the water


run, keep the sewers from backing up, and ensure the roads, elevators, sidewalks, and skies are safe. They have woven themselves so fully into the interstitial spaces of our lives, we only notice these things when they don't work.

As it turns out, software-intensive systems are a whole lot like this. The average citizen living in a digital world sees only a few dominant systems that he or she would identify as distinctly digital. To millennials, Facebook, Google, Twitter, Snapchat, Rdio, Pandora, and others are the digital systems that define their world. An all-too-common view is that these artifacts were all built

by bands of Really Smart 20- and 30-somethings via some mysterious process that involves working in hip buildings with free food, slides, and beanbag chairs. To the legions who are just trying to live, there are a multitude of software-intensive systems that are completely invisible to them and yet are even more essential to their lives: the software in their cars; the systems that keep airplanes from hitting one another; the software-intensive systems that bring food from farm to fork safely, in quantity, and on time; the systems that keep us healthy; and the systems that control the energy we require. There are equally invisible legions of

developers who keep these systems running, whose ways are mysterious, and who are only noticed when things don't work.

**M**odern society cannot function without software-intensive systems, and as I have often said, no matter what future we might envision, it will rely on software that has not yet been built. For us as insiders to computing, we know these things to be true. We are the builders of the digital equivalent of the Great Pyramids, the Empire State Buildings, and—yes—even the basic roads, pipes, and sewers that are in the background and make the world run.

I think that's pretty awesome. We live in a world where an individual developer can change the world; few other disciplines have that scope or leverage. This is the message of empowerment we as insiders to computing have responsibility to bring out into the open. This is the message of the power and the promise of software-intensive systems. This is why we must not only tear back the veil of mystery surrounding what we do but also celebrate with awe and wonder the amazing digital things we've built to form this enchanted world. 

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