

# Reflections

## The World Makers

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Digital twins — realistic digital representations of physical entities, connected by real-time data flow — have spread into varied sectors of society. One sector that deserves further attention is the digital twinning of urban areas. The quick deployment of digital twins of cities and their interactions with the material and social elements of the ‘smart city’ have been enabled by discourses of technological optimism and the hope that smart cities can allow for solutions to ‘hard problems’ like the climate emergency. However, the social and cultural values that underpin the creation and practice of these technologies are not yet well understood. In this essay, I tell the story of Joakim, a man who has created a digital twin of his small hometown. The direction he has taken with his digital twin, one which he believes takes his project beyond the limits of city-centric twins, is guided by his notions of community, democracy and sustainability. Attention to small-scale and grassroots digital twins can help us to reconsider the affordances of digital twins: the ways that they can create multiple representations of reality and can allow users to make actionable predictions. Given digital twins’ increasing importance in the governance of urban areas, a vital first step in becoming more literate in our interactions with the technology is to better understand their social construction.

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### The lay of the land

According to cartographic lore, when Louis XIV was first shown a new map of his domain, surveyed using the latest innovations in optical technology and astronomical triangulation, the Sun King lamented that more of his lands had been lost to the royal astronomer, Giovanni Cassini, than to all of his enemies combined. Advances in technology and scientific method had shrunk the size of France on the map, which just so happened to inspire the king to offer an astute commentary on the world-making effect of maps.

Some three centuries later a drone whirs over the small town of Hemminge, 25 metres above rooftops and croplands and clusters of oaks whose forebears were once studied by Carl Linnaeus.

The drone snaps aerial photos of the picturesque town; the images will later be mosaiced into a comprehensive, photorealistic three-dimensional map by a supercomputer at a nearby university. The person steering the drone is Joakim, a local man intent on showing a city-centric world that even towns and villages can go digital, can do 'smart technology', can do it differently. If the cutting edge in surveying back in the 1680's served to cut into sharper relief the lines and contours of landscape and territory, today's edge slices into deeper layers of social fabric, chisels out in detail the pulsing social arteries of the town. The lines, contours, and polygons that would result from Joakim's mapping were not made for mere graphical representation; they were not cartographic in the traditional sense. They were made to transcend the limits of what ordinary maps can do. These new lines would do their part in creating a digital twin of Hemminge — a 'living' replica of the town, tracking and responding to changes and events recorded by sensors installed throughout the community.

The term digital twin, as typically defined, has come to denote a technical system where a physical object, process, or spatial context, and a digital representation (usually, though not necessarily a three-dimensional (3D) model) of that entity are conjoined, so to speak, by a steady flow of real-time information (Korenhof *et al.* 2021). Imagine a reactive and fine-grained facsimile of your garden plot, humming with a continuous stream of data about the health of each flower, the soil moisture, and the statistical likelihood that horrible pests will invade your plot — whatever is important to you as a gardener — served to you instantaneously on your mobile phone screen. In this digital twin, you could run experiments and make predictions: What would happen if I started using this or that variety of pesticides? How would shade affect my roses if I built that tool shed over there? Bringing together advances in embedded sensor technology, geographical information systems, the internet of things, Artificial Intelligence (AI), and machine learning, digital twins have quickly sprung from vibrant technological advances like dandelions — and versatile and lucrative dandelions at that. The global market for digital twins in the manufacturing industry alone is expected to reach over six billion dollars by 2025, a ten-fold increase in five years' time (Statista 2024). Scientific output is just as meteoric; Scopus tells me that 68 science documents containing the term 'digital twin' in their titles were published in 2017; six years later, the number was 4,190. More than half of them were in computer science and engineering; a measly 2.6% came from the social sciences. Search the web and you will find digital twins of human hearts (ELEM n.d.); digital twins of Pacific nations like Tuvalu facing inundation as sea levels rise (Fainu 2023); projects to rebuild destroyed cities in Ukraine using digital twins (Lambert 2023). There are plans at Nvidia to twin the entire planet, ostensibly to save the planet from the ravages of climate change: "to have a simulation of the Earth that's sufficiently high fidelity that you could test various mitigation and adaptation strategies at a regional level" (Yahoo Finance 2022).

How do these hyper-realistic mapping machines — stretching and bending the relationship between representation and reality, more often than not designed to explicitly intervene in the object simulated — reconfigure our place in that milieu?

In 1991, Gelernter prophesied about the day when computer software would be able to render so-called 'Mirror Worlds' — faithful and real-time simulations of some chunk of reality, right there on your screen. "You will look into a computer screen and see reality," he writes in the book's prologue.

Some part of your world—the town you live in, the company you work for, your school system, the city hospital—will hang there in a sharp color image, abstract but recognizable, moving subtly in a thousand places. (Gelernter 1991, 1)

A few years earlier, Turkle had begun following the ways that new technologies of computer simulation and visualisation established their dominance in various academic and professional fields. Her observations, later collected in the 2009 book *Simulation and Its Discontents*, tell of a growing tension between a younger generation, enthusiastic adopters of these digital innovations in simulation, and a sceptical older generation who feared the abandonment of empirical rigour and traditional methodologies (Turkle 2009). At the heart of the issue of simulation, Turkle suggests, is the question of what simulation wants. What simulation wants is *immersion*; of surrounding us in an exhilarating

state where the space of possibilities seems infinite, where 'screen realities' threaten to frazzle the boundary between the experience of representation and reality. "Simulation demands immersion and immersion makes it hard to doubt simulation," writes Turkle (2009, 8). If this is true, what do the blinders of immersion engendered by digital twins keep their practitioners from seeing? What effects does such a suspension of disbelief exert on their practices?

Turkle's question — what simulation wants — can be supplemented with another that deals more directly with the materiality and social construction of visualisation technologies like maps. Cartographer Wood frames his book *The Power of Maps* around the deceptively simple question of what a map actually *does*. What a map does, he states, is to work. And a map works by drawing into focus *some* aspect of our world, by being selective about the things it brings into being. Hence, the presences and absences that maps embody are reflections of our culture, of our vested interests (Wood 1992). City-scale digital twins emerge alongside a distinct epistemology, hidden from view by a sense of scientific objectivity, persuasive immersion, and technological optimism. What interests do digital twins serve? What cultural and political values do they embody, and how do they construct the reality they claim to merely reproduce?

And how can we think with Joakim and his digital twin of the 5000-person town of Hemminge? With his vision, and with the digital twin he's using to go beyond the limits of city-centric digital twins?

I first learned of Joakim in the midst of my research on a nation-wide push to create digital twins of university campuses. I came across an article on the 'digital clones' he and his partners had created of his small town's local buses. In the article there is an image of Joakim, standing in the front section of a bus, swaying back and forth while he talks animatedly to his fellow passengers. He holds a laptop turned to face his audience, showing a digital representation of the vehicle that moves in lockstep with the physical bus through virtual environs — his digital twin of the town itself. What caught my attention wasn't so much the charming quirkiness of the project, but rather the story of human ingenuity and enthusiasm I found there.

"I moved here when I was three months old, in '64," Joakim told me one summer afternoon in 2023.

Raised in a farmstead in the hills here. Been out and about since then, of course. Moved back twenty-four years ago and built a house in the valley, where I still live. My background is that I'm an electronics technician, a designer. I've worked quite a lot with encryption in the past, many sorts of assignments over the years. Kind of entrepreneurial problem-solving. And then a few years ago I turned my life around. I stopped travelling around the world and started working with local town development instead. Young people were my inspiration. It's kind of like when you get old, you get religion. So, the project... I'm not a religious person, but one's values change. And I thought to myself that it was time for me to do something good, using the skill set that I have.

Armed with a drone and curiosity, Joakim began building a virtual copy of his hometown.

The digital twin of Hemminge, perpetually reconstituted by a steady stream of data and visualised on a computer screen at a knowledge hub in the town centre, is really just the salient tip of the proverbial iceberg. Underlying the digital twin is the network Joakim nurtures, 'Smart Villages' — an on-going and multifarious research hub that has since its inception in 2018 invited global collaborations across scientific disciplines and academic institutes. An overarching purpose of Smart Villages is to establish Hemminge as a virtual test bed with infrastructure for scientific experiments, while at the same time enabling a digital communication platform for the town residents. The advancement of sustainable development guides all its operations. Researchers and students can propose their own sensors for the digital twin and visualise their experiments, with the precondition that their research is open and has some kind of value for the town. "We're quite cocky," Joakim told me.

You know there's this big company, when we began our discussions with them, I thought 'hell, they have a revenue of several billions, what's their interest in our town?' Cool that they are interested of course, but I don't want to involve a company that ends up pilfering data that they then might use and take out a patent on. So I was real cocky, maintaining that this is a social, open thing we're doing here. And I realised that the cockier I was, the more I drew them in. So that's the trick, really, to invite companies that have hearts.

Joakim's project has drawn local and international attention: "we have talked to the European Commission three times; we've had a bunch of seminars; plenty of politicians who are curious about

what we are doing in little old Hemminge.” Hemminge’s success indicates a growing interest in the digitisation of rural areas.

We in the countryside, we have different needs and lifestyles [than in cities]. When I started the project [in 2018], people weren’t thinking about that at all — it was all about Smart Cities.

Digital twins of cities can reasonably be seen as a technological outgrowth of the broader development and spread of ‘Smart Cities’. Writing in 2014, Kitchin points out two related conceptual understandings of a smart city, one focused on material processes and one focused on innovation and entrepreneurialism (Kitchin 2014). On the one hand, ‘smart’ may refer to the material process in which urban spaces are increasingly being interwoven by so-called ‘everyware’ — digital networks of sensors and cameras, citizen sensors, building and traffic management systems, and so on. Tapping this rich vein of real-time information powers a connected infrastructure of information and communication technologies (ICTs) — an infrastructure that renders the physical city and its complex processes more graspable, controllable, and predictable for public and private actors, leveraging civic functions and businesses alike. The second understanding regards the smart city as the establishment of a knowledge-based economy that, through the platform of ICTs, drives innovation and entrepreneurship in the city — a smart city is seen here as one where the intermingling of ICT, human and social capital along with economic policy drives growth and urban management of the city. Subsuming both conceptions of the smart city is an approach to governance that expands the roles of market and technological forces — an approach founded in a neoliberal logic. Crucially, the smart city serves the interests of two actors: large technology corporations, which with the proliferation of smart cities are able to expand their commercial and political clout; and governmental bodies, from local officials to states and supra-national organisations, who see in smart cities the “enticing potential of socio-economic growth — more liveable, secure, functional, competitive and sustainable cities, and the renewal of urban centres as hubs of innovation and work” (*ibid.*, 2).

Juxtaposing this characterization with Joakim’s Smart Villages yields clear similarities and dissimilarities. One of Joakim’s primary objectives with Smart Villages is to dismantle, or at least challenge the dominant rhetoric of ‘urban centres as hubs of innovation’. He told me that in debates about smart cities, he:

observed a difference in how people see things that I found a bit concerning. But I also saw a development opportunity for rural communities. In cities, money is often what drives their digital twins. Here we look at digital twins differently.

Though digital twins of cities such as Virtual Singapore boast visualisation and analytical functions that provide valuable insights about environmental issues, socio-economic factors and a treasure trove of infrastructure data (Walker 2023), most of this information appears to be closed off from the public. In contrast, Joakim’s ambition is that the insights gathered from the diverse array of sensors in the town will be distributed throughout the community. He is thinking about installing a terminal at a local grocery store where people can access the digital twin and see in real time current air quality and traffic noise levels; they will be able to check on the whereabouts of an autonomous delivery bot carrying food and medicine to senior residents. People would also be able to vote on town initiatives directly through this terminal and report issues to the municipality, Joakim suggests.

In Joakim’s Smart Village, there is little of the distanced corporatisation of governance and ‘instrumental rationality’ that Kitchin warns of. But the general shape and content of the technological assemblages that make digital twins of Singapore and Hemminge alike are most often the same — especially the crucial elements of networked sensors and big data.

A potential friction resides in the socio-technological nature of digital twins; a friction between the putative *intentions* of the digital twin (whether it is to increase the well-being and civic participation of citizens or to facilitate economic growth and sustainability), and the opaque and less-understood ways that political and cultural values, ideologies, and biases seep through the technological instruments, algorithms, and data practices that make up the digital twin. The notion of the natural objectivity and ‘goodness’ of data — one that frames smart cities as neutral and based on tried-and-tested scientific methods — conceals the highly situated and contextualised practices of data collection and usage. Data, that lifeblood of digital twins, is never ‘raw’. On the contrary, data is “cooked”

(Gitelman & Jackson 2013, 3) just as soon as it has been selected from a range of other phenomena. Data is inextricably bound up in a complex system of values, beliefs, economic considerations, technological limitations, and other inflections of the social construction of data.

I asked Joakim if he thinks that what can be measured or visualised is determined by the types of instruments available and their intrinsic affordances. Joakim talked about the subjective matter of happiness; he had once been involved with an experimental app where a user was asked to enter their current mood; the app then proceeded to generate a heatmap visualising a population's aggregated mood spatially. A somewhat odd idea, Joakim confessed, but one that, in his mind, may serve to show that novel forms of measurement are possible, and important. Later, Joakim told me that the economic rationale of 'smart buildings' promotes a limited range of sensor measurements. Values such as energy use and spatial optimisation are routinely measured, but what about employees' happiness? "Couldn't one employ camera sensors to gauge how much they smile?" he asked. "Do they smile more in a specific room? Why?" I considered my response. I asked whether perhaps qualitative data could be collected instead, like survey or interview data? But of course, Joakim countered, such data can't be ingested by the digital twin in real time.

The digital twin's need for continuous, real-time data requires a rather restricted diet of quantifiable phenomena. Qualitative information takes time to collect and analyse. But the same information, if quantified (even imperfectly), can meet the technical inclination for live data. And one of the enticing promises of digital twins is the harnessing of big data; the Mirror World dream of doing away with the need for samples and subsets of data opens the prospect of using total population datasets in conjunction with AI. It is easy to imagine that the affordances of technological innovations like digital twins compel the designer and the subject alike to act in ways that capitalise on these strengths. It makes sense; we use the big blunt part of the hammer, not the shaft, when we put down nails. But then there is also the saying, "to a man with a hammer, everything looks like a nail."

Recently, I asked Joakim what was on the horizon for the digital twin and Smart Villages. As part of his advocacy focus on the sustainable qualities of town and rural communities, he is moving forward with a project to 'copy-paste' the technical infrastructure of Smart Villages and the digital twin onto one neighbourhood in a nearby city. He suggests that the awareness-raising possibilities of the technology will help bring about a sense of communal feeling and participation within the neighbourhood, which will in turn set off a spark of green transformation in that section of the city.

It is an intriguing notion: that a certain way of living — along with the social, cultural, and phenomenological aspects that goes with it — can be taught or inculcated in a population through the steering capabilities of digital twins. But perhaps this particular vision is but one variation of a major theme. From Second Life to the Metaverse, our immersion in virtual realities redefines our sense of selves and our sense of place. The question is, who controls the virtual realities we inhabit - what kinds of information are available to us as we undergo this redefinition?

I asked Joakim once what he sees as the role of digital twins in society. "Communication," he said to me, pointing to the explanatory power of 3D visualisation. He eventually expanded this notion of communication, including the power of digital twins to collect, correlate (through the application of AI), and transmit diverse and disparate information to citizens. But through my conversations with Joakim, I have come to understand his digital twin and Smart Villages as a tool which draws the town into a digitally mediated platform for dialogue and participation. I once asked Joakim what the basis was for selecting a specific phenomenon to measure. First off — he explained to me — was the need to get a 3D model up and running in order to visualise the vast amount of data he expected to use, because "if you visualise it with 3D, the absolute majority will understand it". He continued:

to be honest, sometimes we don't really know what we're doing — it's just pure feeling. And when you ask people: 'what do you want to do?', they don't really have an opinion at first. However, if you then show them a proposal, you get counterproposals, like: - 'nah, you can't do that', - 'alright, fine'. We ask them where they think people drive too fast. We ask where we should measure noise levels. So you get that feedback. And that's where it becomes an agile development together with the town residents.

Hemminge's digital twin is a mirror of Joakim's beliefs, values, and visions as much as it is a mirror of the town itself. Its creation — from a 'bricolage' of sensors, software functions, data formats and so on

— have been guided (at least to an extent) by Joakim's conception of 'town life', of those good aspects of a rural community that promotes neighbourly friendliness and social cohesion — elements that, in his mind, are sorely lacking in city life and governance.

During my interviews with people who work with digital twins, I don't recall anyone saying that they ever mistook the twin for reality. But if there ever was a moment when Baudrillard's statement: "the map precedes the territory" rang true in a sense beyond the abstract, then that moment must surely be the present one. In the first few pages of his *Simulacra and Simulation* (Baudrillard 1981), we find his inspiration — an equally apt meditation on digital twins, written over a hundred years before their arrival. The story retold by Baudrillard is a passage from Lewis Carroll's 1893 novel *Sylvie and Bruno Concluded*, and it is so strikingly prescient and, well... funny, that it deserves to be repeated in full

"That's another thing we've learned from your Nation," said Mein Herr, "map-making. But we've carried it much further than you. What do you consider the largest map that would be really useful?"

"About six inches to the mile."

"Only six inches!" exclaimed Mein Herr. "We very soon got to six yards to the mile. Then we tried a hundred yards to the mile. And then came the grandest idea of all! We actually made a map of the country, on the scale of a mile to the mile!"

"Have you used it much?" I enquired.

"It has never been spread out, yet," said Mein Herr: "the farmers objected: they said it would cover the whole country, and shut out the sunlight! So we now use the country itself, as its own map, and I assure you it does nearly as well." (Carroll 1893, 169)

For all their technical differences, the stories of Louis XIV and Joakim that opened this essay share a common thread, an epistemological objective that is arguably as old as human imagination and invention, which is a compulsion to concretize the abstract, to 'map out' some version of reality through technology. We do this by selecting, from an infinitude of phenomena, a specific subset that we believe will best serve our interests, and we arrange our mapping tools to better achieve this objective. It is through this feat of subtraction and sculpting of abstract reality — a magical act that is so natural to us that we hardly ever stop to consider its mysterious wonder — that maps and similar technologies like digital twins allow us to 'operationalize' reality. But with the new lines that we draw with technology — with telescopes and drones, with paper maps and digital twins — we shape our perception of that which is mapped. In recent decades, critical cartographers have been challenging the epistemological fixity of maps through deconstructive approaches that reveal their social and political nature. Now that the hype cycle is gradually giving way to fully functional digital twins in increasingly diverse parts of society, we ought to broaden our critical attention and seek ways to reveal and interrogate the materiality of the technology. We need to gaze beneath the scrim of photorealism and laser precision, past its enthralling effect, to make legible the practices, discourses, and economies inscribed therein. And then perhaps we may permit ourselves to look towards what matters to us and begin to dream up our own digital twins.

Once, when Joakim was standing at an intersection piloting his drone and snapping pics overhead, a sleek old Mercedes slowly pulled up next to him. An elderly gentleman stepped out and beheld the man and the drone. Unsure of how this would play out, Joakim assumed his most soothing and pedagogical demeanour. As a public figure in this small town, he needs to do right by his fellow citizens.

I think about what that gentleman might have made of all this, and of all the changes to the world that technology has brought during the course of his life.

"Every epoch dreams the one to follow", said Michelet (quoted in Benjamin 1999, 4). I wonder if the dreams of any previous epoch ever matched up to what eventually came to pass. If they could conjure up the kind of social reality where digital copies of our hearts and of the Earth can come to us and lay our worries to rest.

The older gentleman smiled, raised both of his thumbs to Joakim, and went on his way.

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