Episode Book

EPISODE #5883

What Happens to Water Between the Plant and Your Tap

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SYNOPSIS

Every litre that leaks is a litre somebody already paid to treat, pump, and chlorinate. This episode digs into the buried network between the treatment plant and the paying customer: the IWA water balance, why "30% lost" is at least three different problems, how district metered areas and minimum night flow let crews hear a leak through a metre of dirt, and why the Infrastructure Leakage Index writes poverty into its own benchmarks. Plus the cities that beat the odds — Tokyo, Phnom Penh, Singapore — and what it took to get there.

TRANSCRIPT



Corn

Herman, we did electricity losses, and Daniel watched us spend forty minutes on transformers and line crews and came back with the obvious sequel.



Herman

The other buried network.



Corn

Water. He wants to know what happens between the treatment plant and the paying customer. A utility pushes a hundred litres of treated drinking water into the pipes. How much arrives? What are the international benchmarks, who delivers nearly everything, who loses an astonishing share, and how do you tell a leaking main from a faulty meter from somebody's illegal tap when all of it is underground?



Herman

And whether there's a floor. Whether even the best system in the world has to lose something.



Corn

That's the part I want. The minimum. The number nobody can get below. Because every litre that leaks is a litre somebody already paid to treat, pump, and chlorinate.



Herman

The headline answer is roughly thirty percent.



Corn

Which is a big number and also a useless one.



Herman

It's useless in the way that matters, yes. Thirty percent of the world's treated water goes into the ground or into somebody's pocket without ever generating revenue, and that thirty percent is not one problem. It's at least three.



Corn

Start with the three.



Herman

The field has a standard framework for this. The IWA water balance. You start with system input volume, everything the utility puts into the network, and it splits into authorized consumption and water losses. Authorized consumption is billed and unbilled, the unbilled part being firefighting, municipal watering, parks, that sort of thing.



Corn

Which isn't a loss at all.



Herman

It's authorized. You meant to give it away. Then water losses split into two very different animals. Real losses, which is physical, water actually escaping. Leakage from mains, from service connections, from storage tanks, overflows. And apparent losses, which is commercial. Unauthorized consumption, so theft and illegal connections, plus metering inaccuracies on both the production side and the customer side, plus plain data-handling errors in the billing system.



Corn

So apparent losses are water you can't account for.



Herman

Water you can't bill for, which is not the same thing. Some of it may have reached a customer perfectly well. You just recorded it wrong.



Corn

Right.



Herman

And this matters because the mix is completely different depending on where you are. In developed countries apparent losses are small, single digits usually. The World Bank estimated that in developing countries, apparent losses, especially theft through illegal connections, average about forty percent of non-revenue water.



Corn

Forty percent of the missing water was never missing. Somebody was drinking it.



Herman

Somebody was drinking it and not paying for it. And in some cities apparent losses are larger than real losses, which means the utility's biggest problem isn't its pipes at all. Its problem is that people are taking water and its meters aren't catching it.



Corn

So Lagos at ninety-six percent and Tokyo at three percent are not the same kind of failure at different magnitudes.



Herman

Not remotely. Lagos pre-2003, that's the worst figure anyone has recorded anywhere. Ninety-six percent unaccounted for. Only four percent of production was generating any revenue.



Corn

That's not a leaking system. That's a system in name only.



Herman

And on the other end, you've got Singapore around five percent, Denmark six, Netherlands six, Germany and Japan around seven.



Corn

So the honest answer to Daniel's hundred litres is about seventy arrive, and in the best-run places ninety-four to ninety-seven.



Herman

Globally, the volume is three hundred and forty-six million cubic metres a day. A hundred and twenty-six billion a year. Liemberger and Wyatt put that together in an update a few years back and the comparison they reached for was river flow. That annual figure is about seventy percent of the average flow of the Niger and nearly half the Ganges.



Corn

We lose half a Ganges a year and it's not a headline anywhere.



Herman

It's invisible. That's the whole issue.



Corn

Here's what I want to sit on, though. You said utilities sort this into real and apparent. How do they actually know which is which? The pipes are underground. You can't walk the network with a clipboard.



Herman

Honestly? Often they don't know.



Corn

Say that again.



Herman

The core instrument is the annual water audit. In principle you account for every component, and the more rigorous version is what's called a validated audit. But an unvalidated desktop audit, which is what most utilities actually produce, carries an error range on real losses of plus or minus fifty percent.



Corn

Fifty percent either way.



Herman

So a utility can report a twenty-five percent loss and the true figure could be anywhere from twelve to thirty-eight. And it doesn't know which end it's at.



Corn

That's not a measurement. That's an opinion with a decimal point.



Herman

Validation is the thing that fixes it, and it's unglamorous. You test the production meters, because if the meter at the treatment plant is reading low you're losing water you never counted. You test a random sample of customer meters. You go through the billing system and eliminate data errors. And you confirm the count of illegal connections by aerial mapping, field surveys, cross-checking databases against each other.



Corn

That last one tells you something about how the theft gets found. It's not a pipe problem at all, it's a records problem.



Herman

Which is exactly why so much of Phnom Penh's turnaround was administrative.



Corn

Hold that. I want the diagnostics first, the machinery for actually finding a leak.



Herman

The workhorse is the district metered area. You take the network and you carve it into hydraulically isolated blocks. Each block has a flow meter on the inlet, ideally just one or two, so that everything entering the block is measured.



Corn

And then?



Herman

Then you look at night. Minimum night flow. At two or three in the morning, legitimate consumption drops to almost nothing. Everybody's asleep. So whatever is still flowing into that block at three in the morning is very close to pure leakage.



Corn

That's elegant.



Herman

Tokyo's blocks average about eleven hundred households each. And they set a threshold. If minimum night flow exceeds something like twenty litres per minute per kilometre of main, at thirty metres of head, that block gets investigated.



Corn

Twenty litres a minute doesn't sound like much.



Herman

It's forty litres an hour. Nine hundred and sixty litres a day. From one block, from one leak you haven't found yet. Multiply that across a city.



Corn

Fair.



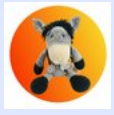
Herman

And then once you've narrowed it to a block, you get finer tools. Night step tests, where you close valves one at a time and watch the flow drop, so you can isolate which section is losing water. And acoustic listening. You put a microphone on the pipe, or a stick against a valve, and you listen for the sound of water escaping.



Corn

The sound of water escaping.



Herman

It's a hiss. Under pressure through a small hole in metal, it's a distinct high-frequency hiss. Through soil it's muffled and lower. Experienced crews know what different leaks sound like.



Corn

There's a whole trade in this. People who can hear a pipe through a metre of dirt.



Herman

There is. And Phnom Penh used the same physics from a different direction. They put electromagnetic flow meters on each distribution block, and they weren't only listening for leaks, they were watching for theft. A block with a suspiciously high night flow could be a burst main or it could be somebody's illegal tap running all night. Same instrument, same reading, completely different diagnosis.



Corn

Which is the thing Daniel was circling. The signature of a leak and the signature of a theft look identical from the meter. The difference is what you find when you go and look.



Herman

That's the heart of it. Night flow tells you water is disappearing. It doesn't tell you why. You still have to walk the street.



Corn

So how do you compare cities, then? Because percentage lost, the number everybody quotes, seems like it rewards the wrong thing.



Herman

It does, and this is the second piece of the puzzle. A low percentage of non-revenue water does not automatically mean a well-run system. It can mean the system is starved. If supply is constrained and everyone is equally short, if water only runs four hours a day, your losses look small because there's nothing to lose.



Corn

The percentage measures scarcity as much as efficiency.



Herman

Which is why the field moved to the Infrastructure Leakage Index. ILI. It's current annual real losses divided by unavoidable annual real losses. Losses you have over losses you can't avoid.



Corn

And what's the denominator?



Herman

That's the interesting part. The IWA built a formula for it. Unavoidable annual real losses in litres per day equals eighteen times the kilometres of mains, plus zero point eight times the number of connections, plus twenty-five times the kilometres of service pipe, all multiplied by the average pressure in metres.



Corn

Three coefficients.



Herman

Eighteen, zero point eight, twenty-five. And the shape of that formula is telling you something. The biggest term per kilometre is the service pipe, twenty-five. Mains are eighteen. Connections barely register, zero point eight each, because a connection is a short fitting, there's not much of it to leak.



Corn

The service lines are the weak point.



Herman

In Tokyo's experience, over ninety-five percent of leaks were on service pipes.



Corn

So the formula already knew what Tokyo spent decades learning.



Herman

The entire formula measures the lowest real losses you could achieve with well-managed infrastructure in good condition. Not perfect pipes, not zero. A well-maintained network still leaks. The people who wrote it compared it to working out the par score for a golf course. It's not the best round anyone has ever played. It's the score a good player should shoot on that course.



Corn

And ILI is your actual score over par.



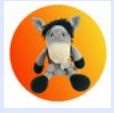
Herman

One is par. Under one means you're beating what the model thinks is achievable, which some small low-pressure systems do. And the classification runs from A1 at the top to D2 at the bottom. With one detail I think is the most honest thing in the whole framework.



Corn

Which is?



Herman

The boundary values are twice as large for low and middle-income countries as for high-income ones.



Corn

They wrote the poverty into the benchmark.



Herman

Explicitly. What's achievable in a city with reliable funding and a century of records is not what's achievable in a city rebuilding after a civil war. The index doesn't pretend otherwise.



Corn

Which means "you should be at ILI one" is not advice you can hand to everyone.



Herman

No. And there's a version of this that goes wrong in the other direction. There's a whole class of loss-reduction consulting that flies into a city, runs a desktop audit, and tells them they're at nine hundred percent of unavoidable, without asking whether the network has ever had the money to be maintained in the first place.



Corn

You can be told you're failing by a formula built on assumptions your city never got to meet.



Herman

Exactly.



Corn

Let's get to the ones who did it. Tokyo first, because I think the staging is the story.



Herman

It's six stages and they took decades, and that's part of why it's useful. In 1945 Tokyo was losing about eighty percent of its water. Which, in a bombed-out city, is not surprising.



Corn

Eighty percent.



Herman

The first stage was the most basic thing imaginable. They put men on the streets to find and fix visible leaks. Leaks you can see. Water coming up through the road.



Corn

And that got them to about thirty percent.



Herman

Just the visible ones. Then from there it turns technical. Sub-surface acoustic detection, the listening sticks, dividing the network into distribution blocks, and drawing accurate maps of where the pipes actually were. That got them to twenty percent by 1955.



Corn

Ten years for ten points, and half of that was drawing maps.



Herman

If you don't know where the pipe runs you can't fix it. Then they replaced cast iron mains with ductile iron. Higher tensile strength, more resistant to ground movement. By 1979, with better equipment and trained crews, they were at fifteen and a half percent.



Corn

Then the stainless steel.



Herman

That's the decisive one. They figured out that over ninety-five percent of the remaining leaks were on service pipes, the little lines running from the main to each building. And they switched those to stainless steel. That took them below five percent.



Corn

All that effort on the big pipes and the problem was the last two metres into the building.



Herman

And then the final shift. They stopped treating it as detection and repair, chasing leaks as they appeared, and moved to systematic pipe replacement on a planned schedule. Replacing pipe before it fails. That preventive maintenance delivered about sixty percent of the total leakage reduction.



Corn

Sixty percent of the gain came from deciding to replace things before they broke.



Herman

By 2008, 2009, Tokyo was at about three percent leakage. Their 2014 figures break down as real losses three point one percent, apparent losses zero point eight, unbilled authorized zero point two.



Corn

So roughly four percent total, and three quarters of it is water in the ground.



Herman

The reduction saved about three hundred and thirty million cubic metres a year. That's the water consumption of a city of two and a half million people. And it cut sixty-five thousand tonnes of CO2 a year, because every litre you don't lose is a litre you don't have to treat and pump.



Corn

The cheapest water is the water you already made.



Herman

That's the line I'd put on the poster.



Corn

Now Phnom Penh. Because Phnom Penh is the one that breaks the story people want to tell.



Herman

In 1993 the Phnom Penh Water Supply Authority was losing seventy-two percent of its water. And its bill collection rate was forty-eight percent.



Corn

So of the water that arrived, they collected on half of it.



Herman

In a city still recovering from the Khmer Rouge period, with almost no institutional memory. And by 2023 they were at eight point seven five percent. They've been in the six to eight percent range since around 2005.



Corn

That's a public utility. Poor city. Post-civil-war.



Herman

And the first thing they fixed was records. They went through the customer database and found thirteen thousand seven hundred unrecorded connections. Twelve thousand nine hundred and eighty phantom customers. One thousand nine hundred and forty-five collective wells that shared a single unmetered connection.



Corn

None of that is engineering.



Herman

None of it. Then universal metering, and upgrading from Class B meters to Class C, which brought bias from about eight percent down to two. Then pipe replacement through the nineties. Then twenty-four-hour leak repair crews, with a target of reaching any reported leak within an hour. Then district metered areas for loss management. And then enforcement, with rewards for informants and actual prosecutions for theft.



Corn

Theft of water. People prosecuted.



Herman

It's theft of a treated product. And the enforcement is the part that needed political cover, because it means going after connections in poor neighborhoods. That's in the World Bank's own analysis. Reducing apparent losses from illegal connections is often beyond what a utility can do by itself, because it requires political support at a level above the utility.



Corn

You can fix a pipe with a crew. You can't fix a neighborhood with a crew.



Herman

And regularizing slum connections can hurt the poor, because the moment a connection is legal it gets billed, and a bill is a bill.



Corn

Here's where I land on Phnom Penh, then. The lesson is not "poor cities can do it if they try." The lesson is that the two hardest things were a database and a political decision.



Herman

The pipes were the easy part.



Corn

Which leads us to London.



Herman

London loses nearly twenty-four percent of its treated water to leaks. And that's only about five points better than thirty years ago.



Corn

Thirty years of work for five points.



Herman

Thames Water has been the center of a long-running argument about ownership and investment. And this is where the comparison gets uncomfortable, because Phnom Penh outperforms London on leakage by roughly a factor of three. A public utility in a poor country, three times better than a privately owned utility in one of the wealthiest cities on earth.



Corn

That's the sentence people screenshot.



Herman

Asit Biswas, who took the Stockholm Water Prize, was blunt about it. His line was that water supply is not rocket science, that we've known what to do for decades, and that British utilities fall well short of good practice, let alone best practice. And he said they could learn a lot from a city like Phnom Penh. He's also said not a single privatised utility comes close to that performance, and that it comes down to management, but that you tend to pay more when it's in the private sector.



Corn

That's a professor with a grudge and I respect it.



Herman

There's a counter-argument and it deserves airing. Chris Gasson at Global Water Intelligence made it. His point is that in a few countries, Germany and Japan being the examples, public funding mechanisms for water work well, but then you get the opposite problem, which is over-investment. You end up with gold-plated utilities and high costs.



Corn

Gold-plated.



Herman

You build to a standard higher than the water actually requires, because there's no shareholder asking why the capital budget is that large.



Corn

So one system underinvests and the other overinvests, and neither is producing the right number.



Herman

And the ownership picture is mixed. Between 2000 and 2019, three hundred and eleven cities in thirty-six countries took their water back into public hands. Remunicipalisation. But that's a political movement as much as a performance story.



Corn

Noted. Where I come out is that the ownership question is the wrong axis. Tokyo is public. So is Phnom Penh. What they share is continuity of management and the willingness to spend money on pipes nobody will ever see.



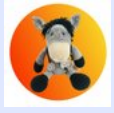
Herman

Which is the actual scarce resource, and the World Bank diagnosed exactly why. Their line is that physical loss reduction is an ongoing, meticulous activity with few supporters. Politicians, because there's no ribbon cutting. Engineers, because it's more fun to design a treatment plant than to fix pipes buried under the road.



Corn

No ribbon cutting. That's the whole thing in three words.



Herman

You can open a desalination plant. You can cut a ribbon in front of it. You cannot cut a ribbon on a mains replacement program, because the entire point is that nothing happens.



Corn

The success is the absence of an event.



Herman

And the funding cycles line up badly. A mayor gets four years. Leak reduction pays back over ten. The person who starts the program is not the person who gets credit.



Corn

So Daniel's last question. Is there a floor?



Herman

There's no single agreed number. The closest thing is the UARL, and that's a system-specific floor, not a fixed percentage. It depends on your kilometres of main, your connections, your service pipes, your pressure. A small system running low pressure through flexible pipe can actually beat it. Most systems can't get near it.



Corn

So "two percent is the floor" is wrong.



Herman

It's wrong in both directions. It's too high for some networks and unattainable for others. Pressure alone moves it enormously, because leakage scales with pressure. Drop the pressure and the loss drops with it, without touching a single pipe.



Corn

And yet nobody wants to drop the pressure, because the customers at the end of the line stop getting water.



Herman

That's the tradeoff. Pressure management is described as one of the most basic and lucrative things you can do to a system, with a fast payback, precisely because it's cheap. But you can only drop it so far before the top floor of the apartment block runs dry.



Corn

So there's a physical floor and a political floor and they're not the same number.



Herman

And there's an economic floor that's contested. Reducing losses to the absolute minimum is not economically rational. At some point finding the next leak costs more than the water it saves. The marginal cost exceeds the marginal benefit and you'd be better off building new supply.



Corn

Except the public health argument cuts the other way.



Herman

It does. A pipe under pressure that's leaking is a pipe with a hole in it, and a hole in a pressurized pipe is a place where contamination can get in when the pressure drops. So there's a real argument that real losses should be driven as low as possible regardless of the economics, because the thing you're protecting isn't the water, it's the integrity of the system.



Corn

Two different floors. One is arithmetic, one is hygiene.



Herman

And the arithmetic one is not small. Liemberger and Wyatt worked out that reducing global non-revenue water by a third, that's a hundred and fifteen million cubic metres a day, would serve eight hundred million more people at a hundred and fifty litres per



Herman (continued)

person per day. And yield about thirteen billion dollars a year. The investment to do it, about sixty-nine billion. Payback just over five years on paper, seven to ten in practice.



Corn

Eight hundred million people, from water we've already treated and are currently pouring into the ground.



Herman

Compare that to building reservoirs. Or desalination. You need capital, you need land, you need permits, you need a decade. And the water isn't better than the water you're already losing. It's the same water.



Corn

It's sitting in the pipe. It's just not arriving.



Herman

The World Bank's 2006 numbers made the same point. Non-revenue water costs utilities about fourteen billion dollars a year. Halving developing-country losses would free up about two point nine billion in cash and serve ninety million more people.



Corn

And the frontier is moving. Machine learning is coming into leak detection. There are papers from the last year or so on unsupervised anomaly detection in water networks, graph neural networks for deciding where to put sensors, and an agent framework for Amman, where half the water is lost.



Herman

Amman is the one to watch. A city where fifty percent of the water is lost, in one of the driest countries on earth, and the proposal is to use the sensor network and the billing data together to find both the leaks and the theft.



Corn

Same combination. Physical and apparent, fixed by the same instrument.



Herman

The old way was a man with a stick listening at a valve at three in the morning. The new way is a model that predicts where the leak should be before anyone hears it.



Corn

I'd trust the man with the stick. The model doesn't know what the hiss sounds like through wet clay.



Hilbert

Fifty-two litres a minute.



Corn

...Hilbert.



Hilbert

Your threshold. Twenty litres per minute per kilometre at thirty metres of head. That's the Tokyo number. The one I worked to was fifty-two.



Herman

Was that a different standard?



Hilbert

It was a different city. Summer, late two thousands. I was on a loss-reduction contract for a council that shall remain nameless, and I spent three months on the night crews. Two a.m. to six a.m., walking the streets with an acoustic stick, which is a piece of brass about the length of your forearm with a diaphragm on the end and a pair of earphones.



Corn

And you could hear it.



Hilbert

You can hear it through the road surface. Through asphalt it's thin and high, almost metallic, because the pipe is close and the ground is dry. Through wet clay it's a low gurgle, and you'd swear it was a drain. Through sand you get almost nothing, because sand swallows the sound. You can walk over a burst main in sand and hear a hiss you'd attribute to a garden tap.



Herman

So the geology changes the signature.



Hilbert

The geology changes everything. Which is why the crews were paid by results and not by hours. You got paid per confirmed leak.



Corn

Paid per leak. That seems like a system with an obvious failure mode.



Hilbert

It had one. Somebody on the crew started marking dry drains as leaks. He got about four hundred pounds before anyone checked. But the best man I ever worked with never marked a false one in two years, and he'd been a postman for thirty-one years before that.



Herman

A postman.



Hilbert

He knew the whole neighbourhood's pipe layout from memory. Not from maps. From memory, from thirty-one years of walking it. He could tell you which houses were on the old cast iron and which had been re-laid in the nineties, because he remembered the roadworks.



Corn

So his knowledge was better than the utility's records.



Hilbert

Considerably. And he could tell a leak from a running toilet by the pitch. A toilet is intermittent and it changes when the cistern fills. A leak is constant. He could stand at the boundary of two properties and say which side of the fence the leak was on.



Herman

How?



Hilbert

He'd listen at the stopcock on each side and compare. Half the time he was right, and the other half the leak was under the fence.



Corn

What happened to him?



Hilbert

He kept a note of everything he found. There was one he reported three times.



Herman

Three times.



Hilbert

There'd been a leak under a road in that neighbourhood since before I was born. Nineteen fifties, some of the infrastructure there. And it had been running the entire time.



Corn

Running for fifty years.



Hilbert

It had been classified as a customer complaint. Filed under noise. That was the category in their system. Customer complaint, subcategory noise.



Herman

So the actual failure wasn't the pipe.



Hilbert

The pipe was fine in the sense that it was doing what pipes do. The failure was a dropdown menu. And the reason it turned up in the end is the meter.



Corn

What about the meter?



Hilbert

There was a meter on the district supply, and the council had been taking a reading from it every month for decades, and the readings were fine. But somebody finally plotted them, the whole history on one page. And the night consumption for that district had been rising slowly for thirty years, by about the amount you'd expect from a leak of that size.



Corn

It was in the data the whole time.



Hilbert

The data was always there. Nobody had plotted it. And here's the thing that made it worse. The meter started running backwards at night.



Herman

Backwards.



Hilbert

Backwards. Because the pressure in the main at night was dropping below the pressure in the district, and it was pulling water back through. So the district's meter was logging negative flow for about two hours a night for a period of years.



Corn

So for two hours a night the utility was being billed for water that ran the other way.



Hilbert

The utility was being billed for water that ran the other way, by the neighbourhood's meter, for years, and nobody looked at the sign on the number.



Herman

Did they fix it?



Hilbert

They replaced the pipe in the spring. It took nine days, because it was under a junction and they had to do it in sections. And the leak was discharging into a culvert that ran under the houses, so the water had been going into the storm drain the entire time and reappearing in the river.



Corn

The river.



Hilbert

Half a mile downstream. You could see it come out. There was a section of bank that never froze in winter.



Herman

So the visible evidence was half a mile from the leak.



Hilbert

And the postman's report said exactly that. Three times. Filed as noise.



Corn

Why are you telling us this now.



Hilbert

Because you said the model predicts where the leak should be before anyone hears it. I'd rather have the postman. He knew where the pipes were because he'd walked over them every day for thirty-one years, and no model has that.



Herman

You're saying the ground truth is a person.



Hilbert

I'm saying the postman had the historical record in his head, because he'd watched the roadworks. The council had the historical record in a dropdown menu. And the dropdown menu said noise.



Corn

What was the pipe actually doing, when they cut into it.



Hilbert

Two inches in diameter. Cast iron. When they got it up it had a crack along the whole length of it, about three feet, and it had calcified over so the crack was holding itself shut along most of the run. It had been leaking out of the ends of the crack where the pressure was highest. They gave it to the foreman. I think it's on a wall somewhere.



Corn

And they're still using the dropdown menu.



Hilbert

As far as I know. Customer complaint, subcategory noise.



Herman

It's the audit problem. That's exactly what the Fanner validation stuff is about. The data exists.



Hilbert

It just wasn't in a column anybody read.



Corn

So what you're saying is that the missing piece for that whole district was a person looking at the number, noticing it was negative, and asking why.



Hilbert

I'm saying the budget was for a new treatment works. That's where the money went.



Corn

The most common wrong belief about this whole topic is that thirty percent lost means thirty percent leaking.



Herman

And the truth is that in a lot of cities most of it never leaked at all. The World Bank's figure is that in developing countries apparent losses, theft and metering error, average around forty percent of non-revenue water. Some cities lose more to meters and illegal connections than they lose to pipes.



Corn

A leaking pipe is a hole you can point at. A meter that reads eight percent low is a different kind of crime scene entirely.



Herman

And it's worse in one specific way. A leak gets bigger and eventually becomes visible. A meter error is perfectly stable. It will read eight percent low for twenty years and never announce itself.



Corn

The leak is a wound. The meter is a habit.



Herman

Which is why the audit matters so much, and why the plus or minus fifty percent error on an unvalidated one is the most important number in this whole field. Because if you don't know the split you can't know what to fix. You can spend a decade replacing mains in a city where the water is actually going out the front door in somebody's house.



Corn

So how low should a utility go?



Herman

To the point where the cost of finding the next leak equals the value of the water it saves. Beyond that you're spending more than you're saving, and the rational move is to stop and put the money into new supply instead.



Corn

But the water came out of a pipe that has a hole in it.



Herman

And a hole in a pressurized pipe is an entry point. When pressure drops, contamination goes in, not water goes out. So the public health argument says drive real losses as low as the physical plant will allow, regardless of what the marginal arithmetic says.



Corn

Two answers, both defensible. One number for the accountant and one for the epidemiologist.



Herman

And the epidemiologist doesn't get to sign the capital budget.



Corn

When Daniel asked whether there's a minimum, I think the real answer is that the minimum is not a number. It's whatever that particular system can achieve with the money and the political attention it actually has.



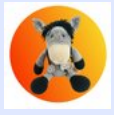
Herman

Which is the UARL. System-specific. Not a percentage you can hold anyone to.



Corn

And the machine learning stuff is going to be interesting. A model that reads the whole billing history and the whole sensor network and finds the leak before anyone hears it, at scale, across a city of millions.



Herman

It's coming. The papers are real. The proof-of-concept work in Amman is the one I'm watching, because half the water there is lost and they have the will to fix it.



Corn

But the model has to be pointed at a number somebody plotted. Hilbert's district had a chart that proved the answer and nobody drew it. The algorithm can't read a dropdown menu either.



Herman

The pipeline is the same. Data in, decision out. Unless a person is looking.



Corn

The thing I'll take from this is that our hundred litres, about seventy of them arrive, and the interesting part is not the thirty that don't. It's the composition of the thirty. In some cities it's almost all holes in the ground. In others it's almost all meters and paperwork.



Herman

The fixes have almost nothing in common. You dig one, and you audit the other.



Corn

Same missing water. Two different disciplines. One is a crew with a listening stick at three in the morning and the other is a person who goes through the customer database and finds the phantom accounts and the collective wells.



Herman

Tokyo spent decades on the pipes. Phnom Penh started with the paperwork.



Corn

I'll take Hilbert's point, actually. The pipes were the easy part.



Herman

We've been making this show for a while now, and I've never once been able to predict when Hilbert has something to say.



Corn

You never can. It's his one reliable trait.



Herman

The other thing I keep coming back to is that this is the rare infrastructure problem where the fix is entirely known. There's no research needed. We know how to detect leaks. We know how to validate meters. We know how to build district metered areas. We know the payback is five to ten years.



Corn

The only scarce input is somebody deciding to fund it.



Herman

That's why the World Bank line about the ribbon cutting is the truest thing anyone has said about it. What's missing isn't the technology. It's a politician willing to spend four years of a term on something the voters won't notice.



Corn

They'll notice if it works. They just won't know that they noticed.



Herman

That's the whole problem. And it's the opposite in a place that succeeds, because nobody cuts a ribbon on a pipe they didn't have to replace.



Corn

My weird prompts dot com, and the RSS feed is there too, and we would love a review if you've got a minute. Send us your own prompt on Telegram at t dot me slash MWP listener bot.



Herman

If you want to go deeper into buried infrastructure that the city sits on top of, the episode on burying power cables under a city is worth a listen. Same problem, different pipe.



Corn

If you want more of this, try episode sixteen, On Deepfakes, SynthID, And AI Watermarking; episode twenty-five seventy-six, The Centimeter-Level Challenge of Burying City Power; and episode thirty-five, The Privacy Gap. This has been My Weird Prompts. Thanks as always to Hilbert Flumingtop, our producer, for the mixing and for the numbers.



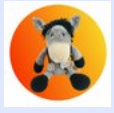
Herman

To Daniel, for sending it in.



Corn

See you soon.



Herman

See you.

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