METACITIES Excellence Hub in South-Eastern Europe

Uncovering the True Value of Digital Twins in Municipalities and Regional Government

White paper

Marios Nicolaou (p-NET)

Table of Contents

1 Introduction 3

2 Start With the Needs of the Municipality 3

3 The People Operating the Region Must Shape the Twin 3

4 Value Discovery Toolbox 4

5 From Data to Decisions 5

6 A Tool for Better Public Investment 6

7 Breaking Down Government Silos 6

8 The Citizen Should Ultimately Be the Beneficiary 7

9 The Digital Twin Should Never Be Finished 7

10 From Digital Twin to Digital Government 8

1 Introduction

Digital twins are becoming an increasingly important part of the digital transformation of cities, municipalities and regional governments. At their most basic level, they can bring together information about roads, buildings, utilities, transport networks, energy systems, environmental conditions, public spaces and many other parts of the physical environment into a continuously evolving digital representation.

The technology behind these systems can be extremely powerful. However, the real value of a municipal or regional digital twin does not come simply from creating a sophisticated 3D model, collecting large volumes of data or deploying advanced analytics. Its value comes from what public authorities can actually do with it: how it helps them understand problems, make better decisions, and ultimately improve outcomes for citizens and society.

That means designing a digital twin must begin with the needs of the municipality or region, not the technology itself.

2 Start With the Needs of the Municipality

A municipal digital twin can potentially support a very wide range of objectives. It could help reduce traffic congestion, improve energy efficiency, plan infrastructure, manage public buildings, monitor environmental conditions, prepare for emergencies, support urban development or improve the delivery of public services.

The possibilities are extensive, but that can itself create a problem. If a municipality attempts to build all of these capabilities at the same time, it can easily end up with a large and complicated technology platform without a sufficiently clear purpose.

The first question should therefore not be, "What technology can we put into the digital twin?"

It should be, "What problems does the municipality need to solve?"

The answer will be different from place to place. One municipality may be primarily concerned with reducing traffic congestion, while another may need to understand where flooding is most likely to occur. A regional authority might want to coordinate infrastructure investment across several municipalities, while another may be more focused on energy efficiency, waste management, water resources, tourism, public transport or climate resilience.

The technology should follow these objectives rather than define them.

3 The People Operating the Region Must Shape the Twin

This is why the people who actually operate and manage the municipality or region need to play a central role in shaping the digital twin.

Municipalities are complex organisations. Different departments are responsible for planning, transport, infrastructure, utilities, environmental management, emergency services, public buildings,

waste collection, licensing, social services and many other activities. Each of these departments sees the city or region from a different perspective and understands different parts of how it works.

An effective digital twin therefore cannot be designed only by technologists. It requires continuous engagement with engineers, planners, municipal officers, emergency-response teams, infrastructure managers and other people who work with these systems every day. They understand operational problems that may not immediately be visible to the people developing the technology.

Their experience helps to uncover the questions that really matter. Where are decisions currently being made with insufficient information? Which municipal processes create unnecessary cost or delay? Which infrastructure problems are difficult to predict? Where could better coordination between departments create value? Which services could become more proactive rather than reactive? What information would allow municipal staff to make better decisions?

These are the questions that reveal the real value drivers of the digital twin. Once they are understood, technologists can begin translating them into specific functions, models, data requirements and analytical capabilities.

4 Value Discovery Toolbox

Finding the real value of a digital twin should be treated as a structured process rather than a one-time requirements exercise. Three groups in particular need to be involved: the Digital Twin Engineers, Municipality Operations, and Citizen Organisations. Each sees the municipality from a different angle, and none can define the digital twin's objectives effectively on their own.

The Digital Twin Engineers understand what the technology can do. They understand the available data, sensors, communications infrastructure, modelling tools, simulation capabilities, analytics and artificial intelligence that can be brought into the digital twin. Their role is important, but they should not begin by presenting a list of technological capabilities and asking the municipality which ones it wants. Instead, they should listen first and then translate real operational and public needs into technical solutions.

The engineers need to work closely with Municipality Operations, because this is where many of the real problems and opportunities can be discovered. The people running transport systems, infrastructure, utilities, planning, emergency services, public buildings and other municipal functions know where existing processes work well and where they do not. They know which decisions are difficult to make, where information is missing, where delays occur and where resources are being wasted.

This exchange should be practical. Municipality staff should describe the decisions they make, the problems they face and the outcomes they are trying to achieve. The engineers can then examine whether better data, modelling, simulation or prediction could help. In some cases the solution may be relatively simple. In others, several datasets and municipal systems may need to be connected before a useful capability can be created.

There is also an important third voice: Citizen Organisations. Municipal operations naturally look at the city from the perspective of running public services, while engineers look at it from the perspective of what can technically be built. Citizens experience the results of those systems in everyday life.

Citizen organisations, community groups, business associations and other representative bodies can therefore help identify needs that may not always appear clearly within municipal processes. They may highlight problems with mobility, accessibility, public spaces, local environmental conditions, neighbourhood development, safety or the quality of public services. Their involvement can also help establish which outcomes citizens themselves consider valuable.

The communication between these three groups should therefore work in both directions.

Municipality Operations can explain what problems need to be solved and which decisions need to improve. Citizen Organisations can explain where the effects are being felt and what improvements would create meaningful value for the community. Digital Twin Engineers can then determine how technology can help address those needs, what information would be required and what capabilities are realistically possible.

But the process should not end when the engineers develop a solution. The proposed capability should return to municipal staff and citizen representatives for review. Does it actually answer the original problem? Does it provide information in a form that municipal staff can use? Would the resulting decision or service create the intended value for citizens?

This creates a continuous feedback process between the three groups: Municipality Operations identify operational needs and decision-making problems. Citizen Organisations identify public needs and desired outcomes. Digital Twin Engineers translate those needs into technical capabilities. The resulting capabilities are then tested against the original operational and public objectives.

Several practical tools can support this process. Workshops can bring municipal departments and engineers together around specific problems. Interviews with operational teams can uncover difficulties that are not visible in formal processes. Citizen consultations can identify priorities and problems experienced within particular communities. Use-case mapping can connect each identified problem with the data, decisions and digital-twin capabilities needed to address it. Pilot projects can then test whether the proposed solution actually creates the expected value before it is expanded.

The important point is that value discovery should not happen only at the beginning of the project. As the digital twin develops, the same process should be repeated. Municipal staff will discover new ways of using the system, citizens' needs will change, and engineers will gain access to new technologies and data sources.

The Value Discovery Toolbox therefore becomes an ongoing mechanism for deciding **what the digital twin should do next**. Rather than allowing technological capability to drive development, it keeps the digital twin connected to operational needs, public priorities and measurable outcomes.

5 From Data to Decisions

This leads to one of a digital twin's most important roles: turning data into decisions.

Municipalities already generate enormous amounts of information. Traffic systems produce mobility data. Buildings generate information on energy use. Utilities collect consumption and network data. Environmental sensors measure air quality, temperature, noise and water conditions. Planning departments maintain extensive geographic, infrastructure and land-use information.

In many cases, the problem is not that the data does not exist. The problem is that it is scattered across different organisations, departments and systems and is difficult to use as part of a broader decision-making process.

A digital twin can provide the layer that connects these sources of information. Instead of data remaining isolated within separate systems, the digital twin can create a more complete operational picture of the municipality or region. This makes it possible to examine how different parts of the urban environment interact with one another.

For example, before approving a major development, planners could examine its possible effects on traffic, public transport, energy demand, water networks and surrounding infrastructure. Before investing in a new road, authorities could simulate different traffic scenarios and compare their consequences. Before extreme weather occurs, emergency-response teams could identify vulnerable areas, critical infrastructure, potential bottlenecks and possible evacuation routes.

Seen this way, the value of the digital twin is not simply that it represents the city more accurately. Its deeper value lies in helping the city understand itself better before acting.

6 A Tool for Better Public Investment

This becomes particularly important when governments make long-term investment decisions. Public infrastructure is expensive, and decisions taken today can influence communities for decades. Mistakes can also be difficult and costly to reverse.

Digital twins provide an opportunity to test different options virtually before committing resources physically. A municipality considering a new transport corridor could compare different routes and their implications. A region planning renewable-energy infrastructure could assess alternative locations, energy flows and network requirements. Authorities considering urban redevelopment could examine how different proposals would affect mobility, population density, public services and infrastructure capacity.

The digital twin can therefore develop into much more than an operational monitoring tool. It can become a decision-support environment for public investment, allowing authorities to explore consequences before money is spent and construction begins.

Better information at this stage can mean lower costs, fewer planning mistakes and a more effective use of public funds.

7 Breaking Down Government Silos

Another important benefit is the ability to improve coordination within government itself.

Public authorities are usually organised into separate departments, each with its own responsibilities, systems and datasets. The physical city, however, does not operate according to these organisational boundaries. A road is not simply a transport asset. It affects utilities, emergency access, commercial activity, surrounding development, public transport and potentially many other systems at the same time.

A digital twin can provide a shared environment in which different departments are able to look at the same physical reality from their own perspectives. Transport planners can see infrastructure information that may affect future mobility. Emergency services can understand road accessibility and potential constraints. Energy planners can examine future development patterns and their implications for demand. Environmental departments can connect pollution data with traffic conditions and land use.

The result is not simply better visualisation. It is the possibility of better coordination. Different departments can begin working from a common picture of the city rather than from separate and sometimes disconnected versions of it.

In this sense, the digital twin can become a platform for collaboration across government.

8 The Citizen Should Ultimately Be the Beneficiary

Ultimately, however, the value created by the system should reach beyond the municipality itself. The immediate users of the digital twin may be planners, engineers, analysts and public officials, but the ultimate beneficiary should be the citizen.

If better traffic management reduces congestion, people spend less time travelling. If improved energy management lowers the operating costs of public buildings, resources can potentially be redirected elsewhere. If infrastructure failures can be identified before they occur, service disruptions can be reduced. If urban development is planned more effectively, neighbourhoods can become better connected and easier to access. If authorities can prepare more effectively for floods, fires or extreme weather events, communities become more resilient.

This means that the success of a digital twin should not be measured only through technical indicators such as the amount of data processed, the number of sensors connected or the sophistication of the 3D model. It should also be measured through improvements in how the city or region actually functions and through the value that citizens experience in their daily lives.

Citizen organisations can also have an important role in this process. Engaging them early can help authorities understand how public priorities, concerns and expectations should influence the development of the system. This is particularly important when the digital twin is intended to support decisions that directly affect neighbourhoods, mobility, public space, services or the wider quality of life.

9 The Digital Twin Should Never Be Finished

Another important principle is that a digital twin should never really be considered finished.

Cities are constantly changing. New buildings are constructed, roads are modified, population patterns evolve, new infrastructure is installed, climate conditions change, technologies develop and the expectations of citizens shift over time. A digital twin that remains static will gradually become less useful.

The system should therefore evolve alongside the municipality.

A city may initially develop a digital twin around a relatively focused objective, such as monitoring traffic or improving the management of municipal buildings. Once the underlying data, models and infrastructure are in place, additional capabilities can gradually be added. These might include energy optimisation, environmental monitoring, infrastructure maintenance, emergency management, development planning or artificial intelligence.

This creates a continuous process of value creation. Operational needs identify new opportunities. Those opportunities lead to new digital capabilities. The new capabilities generate better information and new insights, and those insights reveal the next areas where improvements can be made.

Over time, the digital twin can therefore become an increasingly important part of the municipality's decision-making infrastructure rather than simply another technology system.

10 From Digital Twin to Digital Government

At that point, the idea begins to move beyond the digital twin itself and towards something closer to digital government.

The most advanced municipal and regional digital twins may eventually become shared intelligence platforms through which governments understand the interactions between physical infrastructure, public services, environmental conditions, economic activity and human behaviour.

When information from across a city or region can be connected, visualised, analysed and simulated within a common environment, public authorities gain something extremely valuable: the ability to understand the possible consequences of decisions before those decisions are made.

But achieving this requires the right design philosophy from the beginning.

Technology providers cannot determine a digital twin's value on their own. Municipal leaders, planners, engineers, operators, citizens and other end users need to continuously shape what the system is expected to achieve. Technology then provides the tools to turn those needs into useful capabilities.

> The most successful digital twins will therefore not begin by asking, "What can we model?"
>
> They will begin by asking, "What decisions do we need to make better?"
>
> And once the system begins answering those questions, the next question naturally becomes, "What should our digital twin help us solve next?"

This continuing relationship between technology, government expertise, operational experience, and real public needs creates the true value of municipal and regional digital twins.