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Time to rethink cognitive cities



Contacts

Dubai

Fawaz Boualwan
Partner
+971-2-699-2400
fawaz.boualwan
@strategyand.pwc.com

Luca Giannetti
Senior Manager
+971-56-273-0777
luca.giannetti
@strategyand.pwc.com

Riyadh

Malek Sraj
Principal
+971-52-640-1912
malek.sraj
@strategyand.pwc.com

About the authors

Fawaz Boualwan is a partner with Strategy& Middle East, part of the PwC network. Based in Dubai, he is a member of the technology, media, and telecommunications (TMT) practice in the Middle East. He works with public-sector and private-sector clients across the Gulf Cooperation Council (GCC) countries on shaping digital transformation agendas, developing data and AI strategies, and building data-enabled growth models. He advises senior leaders on how to translate data, AI capabilities, and emerging technologies into measurable value. His recent work includes supporting large-scale digital transformations; establishing enterprise data programs; and helping organizations use AI to improve customer, commercial, and operational performance.

Malek Sraj is a principal with Strategy& Middle East. Based in Riyadh, he is a member of the TMT practice in the Middle East. He works with public-sector and private-sector clients on shaping data agendas and transformation programs, setting up data strategies, and optimizing governance models. His recent work includes advising large-scale government data transformation programs, giga projects, and cognitive cities on the institutional and technology foundations needed to turn data into better decisions.

Luca Giannetti is a senior manager with Strategy& Middle East. Based in Dubai, he is a member of the TMT practice in the Middle East. He leads engagements with public-sector and private clients on strategic planning and operating model design to uncover data and AI value. His recent work includes management of cross-entity government data transformation programs, data and sectoral strategies, and use case portfolio design.

EXECUTIVE SUMMARY

Cities across the world have spent years making themselves smarter – but have they become any more intelligent?

Despite installing sensors galore, building command centers, creating digital twins and adding AI into the mix, more data has yet to evolve into more wisdom. More information alone is not the key to smarter cities, with many still struggling with the same basic question: what should we do next?

That is the gap cognitive cities were meant to close. Smart cities sense what is happening. Cognitive cities should understand why, anticipate what comes next and coordinate a response. Yet many remain caught between those states: technology can surface a problem faster than institutions, data and decision processes can resolve it.

In the Gulf Cooperation Council (GCC), that gap matters especially. Cities face rapidly changing pressures on trade routes, supply chains, energy systems, infrastructure and public services. Resilience requires them to reallocate resources, adjust capacity and maintain service continuity as conditions change.

The problem is not a shortage of technology. Too much smart-city investment still starts with what can be connected rather than what needs to be decided.

A traffic sensor can show congestion rising, a dashboard can show where and AI can predict what may happen next. None of that is enough if the city cannot decide whether to reroute traffic or change signal timings – or trust the data behind that decision.

To move from ambition to impact, cities need two capabilities in parallel: a clear cognitive vision focused on the outcomes and decisions that matter most, and an urban data production system that turns fragmented data into trusted, reusable decision-grade products. Both need clear standards, enforceable governance and fit-for-purpose technology. **If cognitive cities are to deliver on their promise, the thinking needs to change. It's time to stop starting with what can be connected. Instead, cities should start with the outcomes that matter and the decisions that can change them.**

THE GAP BETWEEN SMART AND COGNITIVE

Around 56% of the world's population lives in cities, and cities generate more than 80% of global GDP.¹ The quality of urban decision-making therefore matters far beyond city hall. Mobility, safety, infrastructure, social services and sustainability overlap every day, and decisions in one domain can quickly affect another.

That need for coordinated urban decision-making is especially relevant in the GCC. Cities in the region operate amid changing trade routes, supply-chain pressures and demands on energy systems. They may need to adjust transport and service capacity as visitor and resident flows change, reallocate resources as demand shifts, strengthen safety and security when conditions move beyond normal operating boundaries, protect critical infrastructure and identify emerging areas of economic activity. Doing that requires real-time signals to become coordinated action across the urban system.

Smart-city technology has made those pressures easier to see. Sensors capture conditions across streets and infrastructure. Digital twins can test scenarios before resources are committed. AI can process large volumes of information fast enough to reveal patterns that would otherwise be missed.



BUT SEEING MORE IS NOT THE SAME AS DECIDING BETTER

That is the difference between a smart city and a cognitive one. A cognitive city should be able to sense what is happening, understand why, anticipate what may happen next and adapt. Its intelligence is measured by the quality, speed and coherence of the decisions it enables, not by how much technology it deploys.

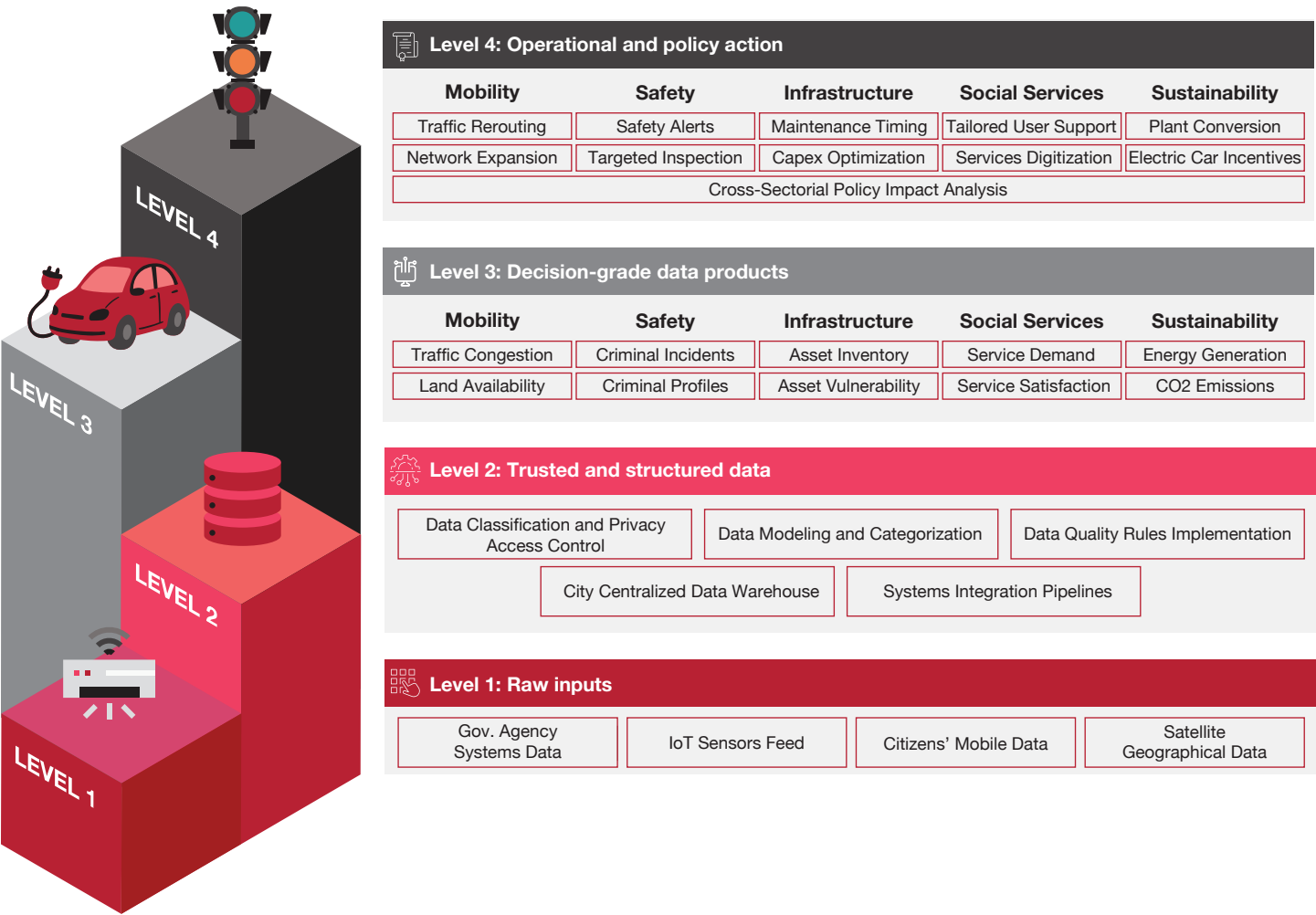
In a cognitive city, what matters is not the amount of data, but its ability to be converted into trusted, reusable decision-grade data products (see *Exhibit 1*). Success depends on enough data being available to reflect how the city functions. That data must be sufficiently trusted to support action, and sufficiently accessible to move across institutional boundaries with clear accountability. Without such a foundation, intelligence will fragment. Each institution may improve its own corner of the system, but the city as a whole will continue to underperform.

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For most cities, the federated approach is optimal. In this approach, a central agency sets the direction, ensures regulatory compliance, resolves conflicts, and fosters value realization. For their part, sector agencies and private players retain autonomy and responsibility with regard to their own data domains.

EXHIBIT 1

The four levels of data for cognitive cities



Source: Strategy& Analysis

THE QUALITY OF DATA DEFINES THE COGNITIVE CITY

Singapore offers a useful glimpse into what a high-functioning data system can enable at scale. The city effectively coordinates more than 70 agencies and supports thousands of datasets and high-volume application programming interface (API) use.²

However, most cities currently lack foundations of the quality required for that level of performance. They still need to do the hard work of getting there.

Fortunately, all urban data does not need to reside in one complex platform or sit under the direction of one powerful institution. What cognitive cities need is a common framework of standards, governance and interoperability. This allows data from different systems to flow securely, retain meaning and support coordinated action.

On top of that common framework sits the intelligence layer. Digital twins create decision foresight by helping leaders test scenarios, so they can assess trade-offs and deal with problems before they become critical. Artificial intelligence (AI) accelerates decisions by turning high-volume urban data into actionable insight and bridging the gap between signal and response. In the U.K., Transport for London's 2024 traffic-signal upgrade illustrates how better data and control systems can be used to improve traffic flow, incident response and network performance.

However, outcomes provide the real test of whether a city is truly cognitive. Outcomes take the form of better decisions, whether they are made in minutes, hours, months or years. When the underlying data is weak, AI and digital twins cannot make the city smarter. They can only achieve failure faster, and at greater scale. Many cognitive city ambitions stall for those very reasons.

TAKING ACTION TOWARD TRANSFORMATION

Despite all the investment in command centers, digital twins, AI tools and smart infrastructure, urban transformation programs often still find it difficult to move beyond pilot mode. The problem is rarely an absence of ambition or technology. More often, cities are trying to build intelligence on foundations that remain too fragmented to support it at scale.

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What is the best way to build a cognitive city? The answer lies in a city's institutional capacity to make trusted data usable over time. In order to achieve this goal, city leaders will need to create two things in parallel: a clear cognitive vision, and an urban data production system that transforms fragmented raw data into trusted, reusable, decision-grade products.



COMMON WEAKNESSES UNDERMINING CITIES' BOLD AMBITIONS

The first weakness is institutional. In many cities, the rules and incentives needed to make data usable across government remain incomplete, unclear or poorly enforced. Command centers are built for monitoring rather than for governing. They have plenty of feeds, alerts and dashboards, but lack sufficient operational authority, cross-agency workflow integration and decision rights. Ownership may be declared but not operationalized. Stewardship may exist on paper but remain under-resourced. Data sharing frequently overlooks private-sector participation, is missing proper incentives and is informal and slow. UN-Habitat's 2025 guidelines reveal how many public authorities still suffer from low participation levels, and only a minority of cities have adopted ethical AI guidelines.³

The second weakness is suboptimal architecture. Technology environments have often evolved sector by sector, with little emphasis on coordination across the urban whole. Legacy platforms sit beside newer cloud tools, data models are fragmented across agencies and integration remains over-reliant on fragile point-to-point connections.

The third weakness is lack of data readiness. In many cities, the data needed to support cognitive use cases is still too sparse, too poorly cataloged, too inconsistently defined and too uneven in quality to sustain trusted action at scale. Cities may generate information, but they still do not have the urban data production system that would convert that information into reliable, decision-grade intelligence. What begins as a bold vision of integrated urban intelligence therefore often ends up as a disparate portfolio of pilots and dashboards. No single decision-maker can ever see the full picture.

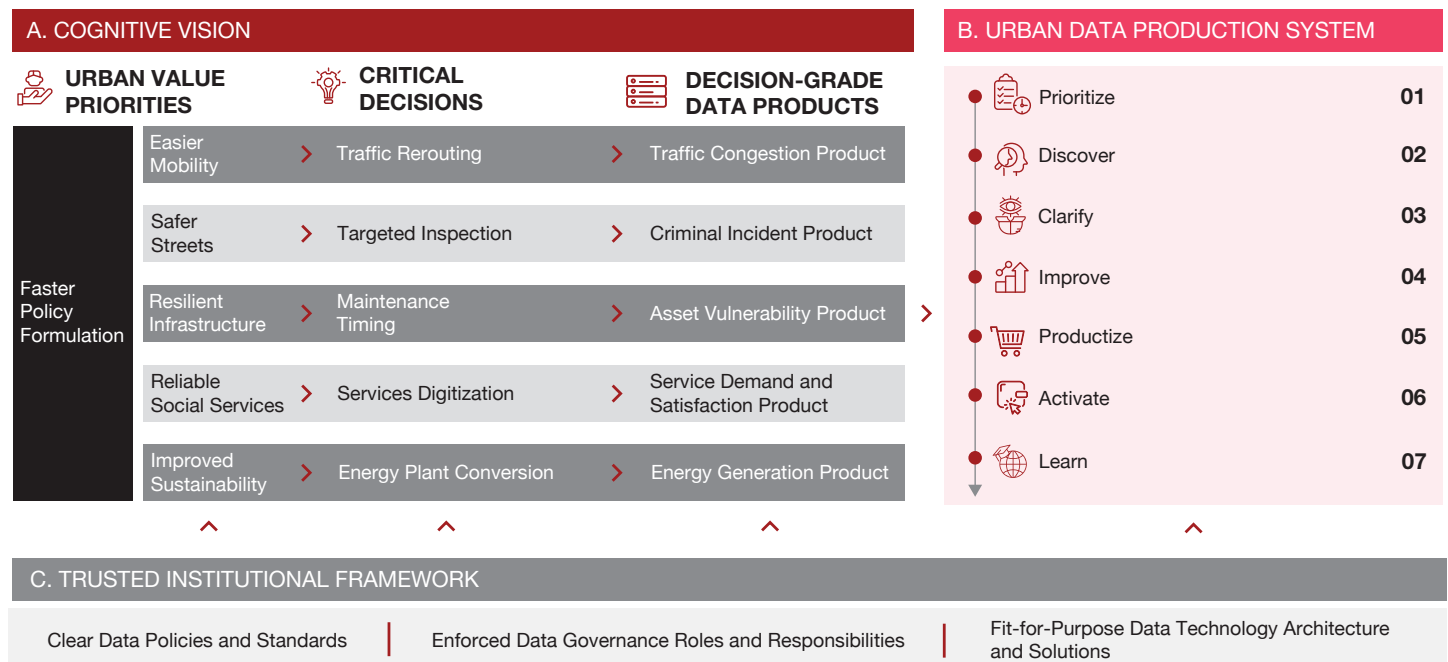
HOW CITIES CAN GET THEIR DATA DECISIONS RIGHT

What is the best way to build a cognitive city?

The answer lies in a city's institutional capacity to make trusted data usable over time. City leaders need two capabilities in parallel: a clear cognitive vision and an urban data production system that transforms fragmented raw data into reusable, decision-grade products (see *Exhibit 2*).

Both depend on strong institutions and disciplined governance. Many city data programs start by asking what data exists, which systems can be integrated or which technologies can be deployed. Yet those questions should follow a more fundamental one: which outcomes matter most, and which decisions must become swifter, stronger or better coordinated? Existing data can reveal the problem; cities should then define the decision and work back to what it requires.

EXHIBIT 2 Essential components of a cognitive city



Source: Strategy& Analysis

A city's cognitive vision must be translated into action. The vision should define the city's core priorities, such as faster policymaking, smoother mobility, safer streets, more resilient infrastructure and more reliable public services. These are more than aspirations; they are design parameters. They determine which use cases matter, what data must be generated and which decision-grade data products are required to improve outcomes across sectors.

The urban data production system is the engine that helps the city achieve its cognitive aspirations.

The first step in building this system is to identify the critical data elements to be prioritized, such as available land area per neighbor, based on the most important decisions set by the cognitive vision, such as road network expansion.

The second step is to identify the owner, for example the transport authority, and the systems from which these critical data elements can be sourced. Once data gaps, semantics and access controls have been clarified, cities must enforce the processes and rules needed to improve data quality, for example through gold medallion architecture, and ensure durable trust. Data productization then entails implementing conceptual, logical and physical data models. These models allow critical data elements to be sourced from multiple datasets and packaged into one single-source table.

Once this source is connected to AI agents or visualization dashboards, continuous smart decision-making is activated. These steps are recurring operational disciplines that can evolve and be refined based on user adoption and feedback. The objective is to industrialize the production of trusted intelligence over time.

Both the vision and the data production system need a trusted institutional framework to ensure long-term success at scale.

THREE ELEMENTS OF A TRUSTED INSTITUTIONAL FRAMEWORK

Element 1: Clear data policies and standards

Policies and standards should provide detailed guidelines on how data is collected and shared, including metadata guidelines, intra-agency service-level agreements and private-sector participation incentives; stored and classified for access, including privacy levels and security frameworks; raised to the required level of quality, including quality dimensions, rules and acceptance thresholds; and modeled and categorized across data domains, including cross-sector conceptual data models and authoritative governance of data sources.

The objective is to create a common language through which data can move reliably between institutions.

Element 2: Enforced data governance roles and responsibilities

An efficient data governance structure needs to be in place, enforceable and enforced. Data maturity, data quality, ease of sharing and realized public value should be monitored through clear and standardized metrics. Roles and responsibilities must be transparent across public and private organizations. For most cities, the federated approach can balance citywide direction with domain responsibility. A central agency sets direction, ensures regulatory compliance and resolves cross-agency issues. Sector agencies and private organizations retain autonomy and responsibility, including ownership and stewardship, for their own data domains.

Element 3: Fit-for-purpose data technology architecture and solutions

Data availability builds on comprehensive coverage of sectors and geography through technology solutions such as CCTV, Internet of Things sensors and satellites. Data quality and accessibility rest on an underlying standardized and integrated architecture that covers the full data life cycle, from ingestion and modeling to publishing and consumption. Because most cities operate in brownfield environments shaped by legacy applications, a phased modernization approach is often practical. This can activate a technology stack that reduces friction in preparing, governing, sharing and using data.



CONCLUSION

Cities in the GCC and elsewhere can no longer be governed as an assortment of disparate departments. Mobility, safety, infrastructure, social services, and sustainability must be treated as a whole, and data holds the key. Building a truly cognitive city means more than installing smarter technology. It means employing trusted, reusable decision-grade data products in order to sustain fast and smart decision-making.

ENDNOTES

1. World Bank Urban Development website.
2. Singapore's open data sharing platform, data.gov.sg.
3. UN-Habitat International Guidelines on People-Centred Smart Cities.

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