DRAFT Preparing for the Citiverse – A Checklist to Evaluate Pre-Implementation

Citiverse Initiative

This is a draft version circulated for comments and should not be considered final or used for official reference, citation, or public distribution.

Foreword

This publication was developed within the framework of the Global Initiative on Virtual Worlds and AI - *Discovering the Citiverse*, which is a global multistakeholder platform launched by the International Telecommunication Union (ITU), the United Nations International Computing Centre (UNICC), and Digital Dubai, and supported by more than 70 international partners.

The Initiative aims to shape a future where AI-powered virtual worlds are inclusive, trusted, and interoperable. By connecting people, cities, and technologies, it empowers meaningful progress through AI-powered virtual worlds.

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Disclaimers

The opinions expressed in this publication are those of the authors and do not necessarily represent the views of their respective organizations, Executive Committee members or Steering Committee members of the Initiative. The findings presented in this report are based on a comprehensive review of existing literature and voluntary written contributions submitted by a diverse range of stakeholders.

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Terms and definitions

This part provides standardized terminology and definitions of key concepts, ensuring clarity and common understanding across all stakeholders.

Table 1 Terms and Definitions

Terms	Sources	Definitions
Metaverse	ITU FGMV-20[1]	An integrative ecosystem of virtual worlds offering immersive experiences to users that modify pre-existing and create new value from economic, environmental, social and cultural perspectives. NOTE – A metaverse can be virtual, augmented, representative of, or associated with, the physical world.
Citiverse	ITU FGMV-34[2]	Option 1: Citiverse-metaverse for cities. NOTE: Citiverse seeks to prioritize a human-centred approach and promote sustainable development. Option 2: Metaverse for cities prioritizing a human-centred approach and promoting sustainable development.
Digital twins	ITU-T Y.4600[3]	A digital twin is a digital representation of an object of interest, (NOTE – A digital twin may require different capabilities (e.g., synchronization, real-time support) according to the specific domain of application.)
Artificial intelligence	ISO/IEC 2382-28[4]	Artificial Intelligence is an interdisciplinary field, usually regarded as a branch of computer science, dealing with models and systems for the performance of functions generally associated with human intelligence, such as reasoning and learning.
Types of designs	Convention on the Rights of Persons with Disabilities[5]	1.Universal Design: Proactive design of products/environments usable by all people to greatest extent possible without adaptation; applies from inception 2.Accessible Design: Reactive design ensuring compliance with accessibility standards for specific disabilities; often involves retrofitting 3.Inclusive Design: Co-design approach involving people with diverse abilities throughout design process.
Types of privacy-enhancing technologies	UN Handbook on Privacy-Preserving Computation Techniques[6]	Cryptographic and mathematical techniques enabling data analysis while protecting individual privacy: 1.Differential Privacy: Adds statistical noise to datasets so individual records cannot be identified 2.Homomorphic Encryption: Enables computation on encrypted data without decryption

		3.Secure Multi-party Computation: Allows multiple parties to jointly compute results without revealing inputs 4.Zero-Knowledge Proofs: Proves statement truth without revealing underlying information"

Explanatory Notes

For the purpose of the present document, the term "City" shall be understood to encompass local, regional and metropolitan governments, as well as their associated international and national bodies (hereinafter referred to as "city")[7]

Abbreviations and acronyms

TABLE: Colored with white lines	
AI	Artificial intelligence
R&D	Research and development
KPI	Key performance indicator
NGO	Non-governmental organization
MIMs	Minimum interoperability mechanisms
NBS	Nature-based and energy efficient solutions
W3C	The World Wide Web Consortium– namely the Web Content Accessibility Guidelines (WCAG), Authoring Tool Accessibility Guidelines (ATAG), and User Agent Accessibility Guidelines (UAAG)
WCAG	The Web Content Accessibility Guidelines
ATAG	Authoring Tool Accessibility Guidelines
UAAG	User Agent Accessibility Guidelines
RoI	Return on Investment

Executive summary

Cities worldwide are navigating a profound shift toward integrating advanced virtual representations – often described as digital twins or immersive urban environments – to enhance planning, management and citizen engagement. This evolving landscape, while not yet uniformly named, represents a convergence of technologies that some are beginning to call the "citiverse". While the opportunity is vast, municipal leaders often ask the same practical questions: Where should we start? How do we build public trust? What capabilities matter most now versus later?

Preparing for the Citiverse – A Checklist to Evaluate Pre-Implementation, attempts to answer these questions with a clear, modular pathway that any city, as well as the broader group of local and regional authorities, can adopt regardless of size, resources or current maturity.

This checklist translates the citiverse vision into a hands-on assessment and evaluation tool. Fourteen domains and 130 indicators help to assess the current state, set targets and prioritize investments. Each indicator follows five answers, with space for evidence, thereby ensuring consistency and transparency.

Key strengths of the checklist:

- Focus on responsible assessment, starting with local priorities and targeted pilots before wider rollout.
- Clear attention to inclusion, accessibility, digital rights and equitable benefits.
- Integrated risk management, including mitigating cognitive influence, preventing internal misuse, managing vendor risk, and ensuring effective compliance, and maintaining crisis response.
- Interoperability and openness to avoid lock-in and enable collaboration across cities.

How to use it:

The checklist is a living management tool that aligns leadership, finance, technical teams and the community. It turns ambition into action, helps cities deliver trusted and inclusive services today, and prepares them for future opportunities and uncertainties in the citiverse.

1. Introduction

Cities are entering a new phase of digital transformation, shaped by artificial intelligence, digital twins, immersive technologies, the virtual worlds and other frontier technologies. The citiverse offers opportunities to improve services, engage citizens and advance sustainability, while also creating new governance and trust challenges.

However, many leaders of cities lack practical tools to assess readiness and plan next steps. Preparing for the Citiverse – A Checklist to Evaluate Pre-Implementation addresses this need. This tool is designed for city leaders to take it as a snapshot of their readiness for the citiverse. It provides a modular framework that any city can use, regardless of size or maturity, to evaluate current capacity, identify priorities and implement change.

The checklist is designed for city leaders, digital and innovation leaders, CIOs and CTOs, public agencies, and partners. It helps cities build trust, ensure inclusion, and prepare for long-term resilience in the citiverse.

2. Purpose

The citiverse represents a bold vision for urban futures – one with which every city can engage, regardless of size, resources or current technological maturity. This adaptable evaluation tool before implementation recognizes that meaningful progress comes in many forms, with each city forging its own unique path towards an effective digital transformation.

2.1 Effective engagement for every city

Cities should determine their engagement level based on local priorities and capacity, leveraging the modular system:

1) **Focused start**: this methodology provides several entry points for cities to engage in ex-ante evaluation, for example, core governance, human capital, institutional frameworks, or ethical guidelines

2) **Tailored approach**: Adjust focus and to reflect specific urban challenges and existing strengths.

3) **Comprehensive adoption**: Progress through all areas for full-scale implementation with integrated systems, building a truly future-ready citiverse.

This modular system accommodates:

1) **Diverse economic contexts**: From global capitals to emerging municipalities.

2) **Varied starting points**: Whether upgrading legacy systems or building digital infrastructure anew.

3) **Distinct ambitions**: From addressing urgent pain points to pursuing visionary

transformation.

2.2 Guiding principles for Citiverse journey

Three core principles guide the evaluation of your readiness to implement the citiverse:

1. Readiness over Eagerness: The position of cities is determined by its current, verified capabilities and established infrastructures, not its future ambitions. Value is placed on an honest assessment of the existing foundation.

2. Local Context Defines the Pathway: The evaluation framework is neutral; a city, or a local or regional authority's unique needs, priorities and existing capacities are what interpret the results and shape the subsequent implementation roadmap.

3. Managed Progression from Simple to Complex: The structure inherently encourages building confidence by validating capabilities before advancing to initiatives that require more complex, integrated systems.

The ex-ante evaluation tool is built on core principles that ensure its utility and reliability as a strategic diagnostic tool:

- Clarity & Consistency: Each of the 130 indicators is presented as a direct, unambiguous statement. The five response options (a-e) for every question form a logical, progressive maturity model, ensuring consistent interpretation and reliable benchmarking across all domains.

- Action-Oriented & Tangible: Options describe tangible states of existence or activity, not intentions or aspirations. This moves beyond "are we doing this?" to "how well, and how systematically, are we doing this?" forcing a realistic appraisal of current capabilities.

- Objective & Evidence-Based: The model is designed to minimize subjective interpretation. Selecting an option requires citing tangible evidence (e.g., an approved policy, a published roadmap, a funded budget line), leading to a consistent and defensible score that reflects reality, not optimism.

- Diagnostic & Forward-Looking: The core value lies in the diagnostic gap analysis. The difference between the current state and the optimized state (option "e") immediately highlights precise areas for improvement, strategic investment, and capacity building, creating a direct link from assessment to action planning.

The checklist provides a clear starting point. An objective assessment creates the necessary confidence and clarity for cities to ensure that all future implementation is built upon a stable base.

2.3 Next steps made simple

- Identify your "Citiverse starting point" by assessing its current status.

- Select initial focus areas with the highest local relevance.
- Build on successes through checklist included in this document.

This document recognizes the complex interdependencies between different elements, which cities should carefully consider after completing their initial assessment. This phased methodology ensures cities can participate meaningfully in shaping tomorrow's urban landscapes while respecting current realities and constraints.

3. Guidance for cities' authorities

3.1 Overview

This section provides a comprehensive assessment tool for leaders of cities to evaluate their readiness for citiverse implementation. The tool covers 14 key domains with 130 indicators across critical capacity areas.

3.1.1 How to use the assessment

This framework is designed as a comprehensive ex-ante evaluation tool to be applied before significant resources are committed to a city's citiverse initiative. Its primary purpose is to provide a rigorous, evidence-based diagnosis of the city's current readiness, foundational strengths, and critical gaps. The assessment is structured to de-risk the initiative by forecasting implementation challenges, informing strategic investment decisions, and creating a clear roadmap for action to maximize the potential for long-term success and public value.

Cities are invited to follow a clear iterative process identify the most relevant areas, complete the checklist, assign scores, and document evidence. The process concludes with a dashboard and action plan that translate findings into next steps.

- You can use the tool to take a snapshot of your readiness of citiverse
- The tool can also be used to address any gaps identified in the assessment
- The tool can help you to develop an action plan including the mobilisation of human, technical, financial resources and timeframes.
- You can also use the tool to monitor implementation of the actions plans.

3.1.2 Descriptions

Each component of the checklist serves a distinct role. The checklist presents indicators, the dashboard summarizes results, the action plan structures follow-up, and supporting sections provide scoring criteria and definitions.

- Main Checklist: Complete assessment with all 130 indicators

- Summary Dashboard: Automated calculations and gap analysis
- Action Plan Template: Prioritized improvement actions
- Domain descriptions: Overview of each assessment domain

3.1.3 Scoring scale

The Five-Point Maturity Model & Scoring System

The options for every question follow a universal progression from non-existence to a state of continuous improvement. Each level is assigned a score that directly correlates to the level of pre-implementation risk in an ex-ante context.

Maturity Level	Score	Description & Ex-Ante Interpretation
a) Absent / Ad hoc	0	High Implementation Risk. The capability is non-existent or entirely unplanned. Any activity is reactive and unstructured. Proceeding without this foundation is building on sand, with a high probability of failure.
b) Aware / Exploring	1	Significant Risk / High Dependency. The need is recognized. Initial, unstructured exploration (discussions, research) is underway, but no formal plans or resources are committed. The initiative is highly vulnerable to the outcomes of these early explorations.
c) Defining / Developing	2	Moderate Risk / Foundational Activity. Formal processes, policies, or plans are actively being created (e.g., a draft is under review). This is essential work, but the project remains at risk until these plans are finalized and approved.
d) Implemented / Operational	3	Low Risk / Prerequisite Met. The capability is formally established, funded, and in active use. Policies are approved, systems are live, and dedicated resources are in place. This indicates a solid foundation, significantly de-risking the initiative.
e) Optimized / Embedded	4	Very Low Risk / Strategic Advantage. The capability is advanced, measured, continuously improved, and integrated into long-term strategy and culture. This is a strategic strength that positions the initiative for accelerated success and greater impact.

3.1.4 Step-by-Step Assessment Process

To ensure a robust and credible evaluation, follow this structured process:

1. Convene a Cross-Functional Panel: Assemble a diverse group of internal and external

representatives from all relevant domains, including IT, Strategy, Finance, HR, Legal, Communications, and Operations. This ensures a holistic and unbiased perspective on readiness and risk.

2. Conduct a Systematic Evidence-Based Review: For each of the 130 indicators, the panel must discuss and debate the current state. The conversation must be grounded by asking: "What concrete evidence can we cite to prove our current state?" (e.g., a document, a budget, a system in production).

3. Reach a Consensus Selection: The panel must agree on the single option (a-e) that most accurately reflects your pre-investment reality. If consensus is difficult, this often indicates a capability that is immature or poorly communicated.

4. Document Rationale & Evidence: For each indicator, briefly document the key evidence and rationale for the selected score. This creates a crucial audit trail for decision-makers, provides context for future reassessments, and is the foundation for the subsequent action plan.

5. Analyse Results and Inform Strategy: Aggregate the scores to create a strategic readiness profile.

    - Identify Critical Gaps (Showstoppers): Indicators scored 0 (Absent) or domains with an average below 1.5 are critical gaps that pose a high risk of failure. These must be addressed as immediate pre-conditions.
    - Identify Developing Areas (Significant Risk): Scores of 1 (Aware) or domain averages between 1.5 - 2.4 indicate areas that require immediate development and resourcing to de-risk the project.
    - Identify Strengths (Ready): Scores of 3 (Implemented) or domain averages of 2.5 - 3.4 indicate a solid foundation. The initiative can proceed with confidence in these areas.
    - Identify Strategic Advantages (Levers): Scores of 4 (Optimized) or domain averages above 3.5 represent core competencies and competitive advantages that should be leveraged to accelerate the entire initiative.

3.1 5. From Assessment to Action

The final output of this ex-ante evaluation is intended not only as a scorecard but as a source of evidence for decision making and ultimately an input into strategic planning processes in the public sector:

- Phased Investment Plan: The results provide a clear, prioritized sequence for action and investment. The maturity model logically dictates the necessary steps to advance each capability, creating a disciplined, de-risked implementation roadmap.

- Informed Go/No-Go Decisions: The overall profile allows leadership to make a data-driven decision on whether to proceed, delay, or re-scope the citiverse initiative based on the actual readiness.
- Baseline for Future Evaluation: This assessment establishes a quantitative baseline against which future progress can be measured in subsequent ex-post evaluations, demonstrating the value and impact of the investments made.

3.2 Domain descriptions

The Checklist is structured around fourteen domains. Each domain represents a critical area of capacity that cities need to address, in order to prepare for and implement the citiverse. Together, these domains provide a comprehensive view of governance, infrastructure, innovation and long-term sustainability.

Table 2 Domain Descriptions

Domain	Name	Description
D1	**Vision and Strategy**	Ensures strategic clarity, long-term vision, and alignment with existing city plans and international frameworks, translated into actionable roadmaps with clear accountability and resources.
D2	**Barriers to Implementation**	Identifies and assesses administrative, cultural, technological, and legal obstacles, as well as coordination gaps, to de-risk implementation and proactively manage change.
D3	**Use Case Pipeline**	Defines a structured portfolio of short, medium, and long-term applications with a clear, evidence-based implementation approach (e.g., PoC to scaling) to deliver tangible value.
D4	**Governance and Regulations**	Establishes robust legal, ethical, and policy guardrails for citiverse operations, including data and AI governance, to ensure accountability, trust, transparency, and compliance.
D5	**Technology Infrastructure**	Assesses the readiness and viability of foundational technologies, infrastructure, and interoperability standards to support a scalable, secure and integrated citiverse platform.
D6	**Data Privacy and Protection**	Evaluates the management of data assets – from identification and collection to privacy and protection – ensuring ethical use and robust security for all citiverse-related data.
D7	**Security and Resilient**	Identifies and analyses cybersecurity threats, vulnerabilities and crisis response capabilities to protect citiverse systems, critical infrastructure and user safety.
D8	**Inclusivity and Accessibility**	Ensures citiverse services are universally accessible, available in relevant languages, and designed around diverse user needs (such as gender) through rigorous testing and inclusive principles.
D9	**Human Capital**	Maps quantitative and qualitative skill gaps and establish plans for recruitment, training, and partnerships to build the workforce required to deliver and sustain the citiverse.
D10	**Financial Capital**	Assesses the robustness of funding models – including public, private, and blended finance – and frameworks for measuring return on investment and long-term financial sustainability.

D11	**Adoption and Incentives**	Drives uptake and engagement through targeted awareness campaigns, incentive programmes, and clear adoption metrics to ensure the citiverse achieves its intended societal impact.
D12	**Ecosystem and Stakeholder**	Fosters a vibrant innovation ecosystem by aligning the needs and contributions of academia, private sector, citizens and international partners through structured engagement.
D13	**Trust and Safety**	Establishes robust governance, security protocols, and operational frameworks to ensure the ethical deployment, reliability and continuous safe functioning of technological systems.
D14	**Success and Impact**	Continuously measures, monitors, and optimizes system performance, user experience, and strategic impact through data-driven feedback loops and benchmarking. Ensures the citiverse delivers demonstrable social, economic and environmental benefits, while guaranteeing equity and user wellbeing for all participants.

4. Checklist

The checklist translates the assessment into concrete indicators across 14 domains. It enables cities to assess their current status, set targets, and prioritize actions systematically.

4.1 Domain 1: Vision and Strategy

This domain evaluates whether the city has established a clear vision, dedicated leadership, ethical oversight, and long-term governance mechanisms to guide citiverse initiatives.

4.1.1 Alignment with existing smart city / digital transformation strategy

D1-1 Policy Statement
Is there a published citiverse or virtual-worlds policy or strategy endorsed by the council, linked to the city's overall strategic plan?
a) There is no approved smart city (or digital transformation) strategy at the city level.
b) A smart city (or digital transformation) strategy is currently being drafted at the city level.
c) The citiverse strategy is currently being aligned with the approved smart city (or digital transformation) strategy at the city level.
d) The citiverse strategy is already aligned with the approved smart city (or digital transformation) strategy at the city level.
e) The citiverse strategy is already with the published approved smart city (or digital transformation) strategy and areas of contribution and linkages are identified including initiatives, timelines, and responsibilities.

D1-2 Smart City Integration
Is the citiverse strategy explicitly integrated with and complementary to the city's existing Smart City, Digital Transformation, and broader urban development master plans?
a) The citiverse is pursued as a standalone initiative with no formal links to other city plans.
b) Informal discussions have begun on how the citiverse might relate to other city strategies.
c) A formal process is underway to map dependencies and synergies between the citiverse strategy and other city master plans.
d) The citiverse strategy is formally integrated and references specific goals and initiatives from other city master plans.

e) The citiverse is a core, cross-cutting enabler within all major city plans, with joint working groups, shared KPIs, and integrated budgets for delivering common urban development objectives.

4.1.2 Alignment with international agreements

D1-3 Alignment with Macro International Frameworks
Are citiverse initiatives aligned with international frameworks/principles/compacts such as Global Digital Compact, Sustainable Development Goals, New Urban Agenda, and so on?
a) No consideration is given to international frameworks in citiverse planning.
b) Awareness exists of relevant frameworks, but they have not yet influenced citiverse initiatives.
c) A mapping exercise is underway to align citiverse goals with specific targets of international frameworks.
d) Citiverse initiatives are explicitly designed to contribute to prioritized targets of key international frameworks.
e) The city publicly reports on its citiverse contribution to international frameworks, using them as a core design principle and a benchmark for performance and accountability.

4.1.3 Vision for Citiverse

D1-4 Digital Sovereignty and Policy Autonomy
Can our city harness digital sovereignty and policy autonomy to drive inclusive growth, build resilience, and spur innovation within the emerging citiverse economy?
a) The city has no stated position on digital sovereignty and relies entirely on external platforms' terms of service.
b) The concept is under discussion, but no concrete policies or actions to assert local control have been defined.
c) The city is developing a principles-based framework for digital sovereignty in the citiverse, focusing on data control and local value capture.
d) The city actively implements policies (e.g., local data infrastructure, ethical procurement rules) to ensure citiverse development aligns with local laws and community values.
e) The city is a recognized leader in urban digital sovereignty, with a proven model that leverages its policy autonomy to create a resilient, innovative, and inclusive local citiverse economy, attracting global partnerships.

4.1.4 Strategy for Citiverse

D1-5 Innovation Governance
Are innovation management processes established with clear decision-making authorities?
a) There are no defined processes for managing or approving citiverse innovation projects.
b) Ad hoc processes are used, with decision-making authority unclear or based on seniority.
c) A standardized innovation pipeline process is being designed, with draft RACI (Responsible, Accountable, Consulted, Informed) charts.
d) A formal innovation governance framework is approved, with clear stage-gates, funding gates, and designated decision-making bodies.
e) The governance framework is dynamic, with performance data from past projects continuously refining decision-making criteria and accelerating the path from idea to impact.

D1-6 Strategic Performance Metrics
Are KPIs aligned with city strategic objectives and regularly monitored?
a) No specific KPIs have been defined for citiverse initiatives.
b) KPIs exist but are primarily output-based (e.g., number of users) and not linked to city strategic objectives.
c) A draft set of outcome-based KPIs, aligned with city objectives, is under development.
d) A balanced scorecard of KPIs is formally adopted, regularly monitored, and reported to leadership.
e) KPIs are integrated into a real-time performance dashboard, triggering automated alerts and resource reallocation when targets are off-track, enabling proactive management.

D1-7 Change Leadership
Are change management capabilities embedded in leadership structures?
a) Leadership views citiverse as a purely technical project with no special change management needs.
b) The need for change management is acknowledged, but no dedicated resources or skills are in place.
c) Basic change management training has been provided to project leads, but it is not consistently applied.
d) Certified citiverse change managers are embedded in core citiverse teams of the organization, and leadership communication explicitly addresses the transformation journey.
e) Change leadership is a core competency assessed in all managers; a network of change champions drives adoption, and lessons learned are institutionalized.

D1-8 Long-Term Non-partisan Oversight
Does our city have truly independent, long-term governance and oversight structures for the citiverse that are insulated from political cycles and special interests, with measurable protections against short-term decision-making?
a) Citiverse governance is entirely managed within the current political administration with no independent oversight.
b) Discussions about the need for independent oversight have occurred, but no structures are in place.
c) A proposal for an independent oversight board has been drafted and is under review by stakeholders.
d) An independent, multistakeholder oversight board with fixed, staggered terms has been formally established.
e) The oversight board has statutory powers to review major decisions, its recommendations are publicly binding, and its funding is secured via an endowment, ensuring complete operational independence.

D1-9 Adaptive Decision-making and Foresight
Does our citiverse governance systematically incorporate futures thinking – through dedicated foresight capacity, adaptive decision-making structures, and participatory mechanisms to navigate multi-decade uncertainties – while ensuring plans evolve with changing realities?
a) Planning is entirely reactive and short-term, with no futures thinking capacity.
b) Ad hoc workshops or consultants are used occasionally to explore future trends.

c) A dedicated foresight function exists within the strategy unit, producing regular environmental scans for citiverse planning.
d) Foresight is integrated into annual strategic reviews, using scenarios to stress-test plans and inform adaptive decision-making protocols.
e) The city employs continuous horizon scanning, participatory futures exercises with citizens, and has a "dynamic strategy" model where plans automatically adapt based on predefined signals and triggers.

4.1.5 Action Plan / Programme to implement citiverse

D1-10 Executive Sponsorship
Is there dedicated C-level leadership with clear accountability and oversight for citiverse initiatives, directly supported by the Mayor or Deputy Mayor to ensure alignment with civic goals?
a) There is no designated C-level sponsor for citiverse initiatives.
b) A C-level executive has been informally asked to "look into" the citiverse.
c) A C-level sponsor has been formally appointed, but their mandate and authority are still being defined.
d) A C-level Chief Digital Officer or equivalent has a clear mandate, budget, and regular reporting line to the Mayor's office.
e) The C-level sponsor has cross-departmental authority, is a public advocate, and their performance is tied to the successful delivery of civic outcomes through the citiverse.

D1-11 Phased Implementation Roadmap
Is there a publicly available, time-bound implementation roadmap that clearly distinguishes between Proof-of-Concept (PoC), Prototype, and full-scale deployment phases for major citiverse initiatives?
a) There is no documented implementation roadmap.
b) An internal, high-level timeline exists but lacks specific phases or public visibility.
c) A detailed roadmap with PoC, Prototype, and Deployment phases has been drafted for internal review.
d) A time-bound, phased roadmap is approved and published, with clear objectives and criteria for each stage.
e) The published roadmap is a living document, dynamically updated with real-time progress, lessons learned from each phase, and adjusted based on performance and citizen feedback.

D1-12 Implementation Methodology
Has the city selected and documented a formal implementation methodology (e.g., Agile, Stage-Gate) for citiverse projects, with clear stage gates and go/no-go decision points?
a) Projects are executed on an ad hoc basis with no standardized methodology.
b) Teams are encouraged to use agile methods, but this is not mandated or applied consistently.
c) A formal methodology has been selected and is being piloted on one or two citiverse projects.
d) A city-approved implementation methodology is mandated for all citiverse projects, with defined stage gates and decision authorities.
e) The methodology is optimized for citiverse, incorporating hybrid agile-stage-gate elements, and is supported by automated tooling for workflow and decision tracking.

D1-13 Citiverse Innovation Investment

Does the citiverse initiative allocate a dedicated annual innovation budget that is (a) proportional to its strategic roadmap (e.g., ⩾X% of total funding), (b) explicitly earmarked for experimental pilots (e.g., AI-driven urban simulations, immersive citizen engagement tools), and (c) benchmarked against comparable metaverse/digital twin projects in peer cities or industries?
a) No dedicated innovation budget exists; experimental work must compete with operational funding.
b) A small, discretionary fund exists but is not proportional to the roadmap or formally earmarked.
c) A proposal for a dedicated innovation budget, benchmarked against peers, has been submitted for approval.
d) A dedicated annual innovation budget (e.g., 10–15% of total programme funding) is approved and allocated for experimental pilots.
e) The innovation budget is managed as a portfolio, with a mix of high-risk/high-reward bets and incremental improvements, and its ROI is rigorously evaluated to inform future allocations.

D1-14 Technology Roadmap
Are technology evolution pathways and upgrade strategies planned?
a) Technology decisions are made reactively, with no long-term planning.
b) A list of desired technologies exists, but no formal roadmap or upgrade strategy.
c) A 1–2 year technology roadmap is under development, focusing on initial deployment.
d) A 3–5 year technology roadmap is approved, including planned upgrades, refresh cycles, and vendor evolution paths.
e) The technology roadmap is integrated with the city's overall IT strategy, includes contingency plans for disruptive technologies, and is reviewed quarterly.

4.1.6 KPIs for Citiverse

D1-15 KPI Tracking System
Are comprehensive measurement systems implemented for tracking project outcomes?
a) Project outcomes are tracked manually through sporadic reports.
b) Basic spreadsheets are used to track a limited set of financial and schedule metrics.
c) A dedicated project management software is being implemented to track a broader set of KPIs.
d) An integrated dashboard provides real-time visibility into project outcomes against targets for schedule, budget and scope.
e) A predictive analytics system is in place, using project data to forecast outcomes, identify risks, and recommend corrective actions before issues arise.

Table 3 Domain 1: Vision and Strategy

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D1-1	Policy Statement	Is there a published citiverse or virtual-worlds policy or strategy endorsed by the council, linked to the city's overall strategic plan?			
D1-2	Smart City Integration	Is the citiverse strategy explicitly integrated with and complementary to the city's existing Smart City, Digital Transformation, and broader urban development master plans?			

D1-3	Alignment with Macro International Frameworks	Are citiverse initiatives aligned with international frameworks/principles/compacts such as Global Digital Compact, Sustainable Development Goals, New Urban Agenda, etc.?			
D1-4	Digital Sovereignty and Policy Autonomy	Can our city harness digital sovereignty and policy autonomy to drive inclusive growth, build resilience, and spur innovation within the emerging citiverse economy?			
D1-5	Innovation Governance	Are innovation management processes established with clear decision-making authorities?			
D1-6	Strategic Performance Metrics	Are KPIs aligned with city strategic objectives and regularly monitored?			
D1-7	Change Leadership	Are change management capabilities embedded in leadership structures?			
D1-8	Long-Term Non-partisan Oversight	Does our city have truly independent, long-term governance and oversight structures for the citiverse that are insulated from political cycles and special interests, with measurable protections against short-term decision-making?			
D1-9	Adaptive Decision-making and Foresight	Does our citiverse governance systematically incorporate futures thinking – through dedicated foresight capacity, adaptive decision-making structures, and participatory mechanisms to navigate multi-decade uncertainties – while ensuring plans evolve with changing realities?			
D1-10	Executive Sponsorship	Is there dedicated C-level leadership with clear accountability and oversight for citiverse initiatives, directly supported by the Mayor or Deputy Mayor to ensure alignment with civic goals?			
D1-11	Phased Implementation Roadmap	Is there a publicly available, time-bound implementation roadmap that clearly distinguishes between Proof-of-Concept (PoC), Prototype, and full-scale deployment phases for major citiverse initiatives?			
D1-12	Implementation Methodology	Has the city selected and documented a formal implementation methodology (e.g., Agile, Stage-Gate) for citiverse projects, with clear stage gates and go/no-go decision points?			
D1-13	Citiverse Innovation Investment	Does the citiverse initiative allocate a dedicated annual innovation budget that is (a) proportional to its strategic roadmap (e.g., $\geqslant$ X% of total funding), (b) explicitly earmarked for experimental pilots (e.g., AI-driven urban simulations, immersive citizen engagement tools), and (c) benchmarked against comparable metaverse/digital twin projects in peer cities or industries?			
D1-14	Technology	Are technology evolution pathways and			

	Roadmap	upgrade strategies planned?			
D1-15	KPI Tracking System	Are comprehensive measurement systems implemented for tracking project outcomes?			

4.2 Domain 2: Barriers to Implementation

4.2.1 Administrative, structural, cultural, legal, and technological

D2-1 Change Readiness Assessment

Has organizational culture and readiness for citiverse digital transformation been evaluated?
a) No assessment has been conducted.
b) An informal, high-level assessment of potential challenges has been discussed.
c) A formal change readiness survey has been distributed and is being analysed.
d) A detailed change readiness report has been completed, identifying key cultural barriers and champions.
e) Readiness is monitored continuously, and a targeted change intervention plan is actively being executed and measured for effectiveness.

D2-2 Procurement Agility

Are procurement processes adapted to efficiently and flexibly acquire technology, especially for citiverse initiatives, while respecting mandated regulatory oversight?
a) Standard, lengthy procurement processes are used for all technology, as prescribed by standing regulations, significantly hindering the swift acquisition of innovative or agile solutions.
b) Exceptions for agile procurement are possible, respecting necessary regulatory checks, but require high-level approvals, leading to their infrequent use and limited practical impact.
c) A pilot programme for flexible procurement is being tested (e.g., modular contracting, challenge-based procurement, or direct pathways for acquiring open-source and interoperable solutions), balancing agility with regulatory compliance.
d) Formal agile procurement pathways are established, regulated, and commonly used for citiverse-related acquisitions, operating with clear, delegated authority and streamlining time-to-market.
e) The city's procurement system is a recognized leader in agility, featuring outcomes-based bidding, dynamic contracting, and pre-qualified vendor pools for citiverse projects, all operating under a fully modernized and accountable regulatory framework that prioritizes interoperability and avoids vendor lock-in.

D2-3 Legacy System Integration

Are existing systems integrated with new citiverse infrastructure?
a) No plan or capability exists to integrate legacy systems with new citiverse platforms.
b) The integration challenge is acknowledged, but no concrete strategy or budget is allocated.
c) An integration strategy and architecture are being designed, including API-led connectivity plans.
d) A dedicated integration layer or platform is implemented, enabling secure data exchange between key legacy systems and the citiverse.
e) Legacy system modernization is strategically aligned with citiverse rollout, creating a seamless data fabric across old and new systems.

4.2.2 Potential resistance and support

D2-4 Societal Readiness Levels
Has the local community demonstrated readiness to adopt and adapt to citiverse technologies?
a) No assessment of societal readiness has been conducted.
b) Anecdotal evidence suggests a mix of excitement and scepticism, but no data exist.
c) Initial surveys or focus groups have been conducted to gauge public awareness and concerns.
d) Robust, demographic and gender specific data on societal readiness is available and informs public engagement strategies.
e) A "societal readiness index" is tracked over time, and engagement programmes are dynamically adjusted to build trust and literacy in areas of low readiness.

D2-5 Public Trust
Are citizen trust, online safety, and misinformation mitigation strategies embedded into citiverse governance and strategy?
a) Trust and safety are considered secondary to technological deployment.
b) These issues are recognized as important but are not formally addressed in governance documents.
c) Draft principles for trust and safety have been written and are under stakeholder review.
d) Formal policies on digital rights, safety, and counter-misinformation are approved and published.
e) Trust indicators are a primary KPI; independent audits of safety protocols are routine, and a rapid response team exists to address trust-related incidents.

4.2.3 Coordination mechanisms

D2-6 Partnership Governance
Are partnership frameworks established with clear roles and consensus-building mechanisms for stakeholder alignment?
a) Partnerships are formed on an ad hoc basis with loosely defined roles.
b) A standard partnership agreement template exists but is not tailored for complex citiverse projects.
c) A draft partnership governance framework for citiverse, including RACI charts, is being socialized with potential partners.
d) A formal framework is in use, defining decision rights, IP ownership, conflict resolution, and value-sharing models.
e) The partnership framework is a competitive advantage, enabling the city to rapidly form and manage high-performing consortia for citiverse challenges.

D2-7 Multilateral and multilevel government collaborations
Are you working with or planning to work with other local, regional, national or supranational governments on citiverse implementation?
a) There is no collaboration with other government levels on citiverse.
b) Informal knowledge sharing occurs with neighbouring municipalities.
c) Formal working groups are being established with regional/national bodies to align strategies and standards.
d) The city is an active member of a national or supranational network of cities collaborating on citiverse policy, procurement, and technology.
e) The city leads a coalition of governments to jointly develop and fund shared citiverse

infrastructure, setting de facto standards for the region.

Table 4 Domain 2: Barriers to Implementation

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D2-1	Change Readiness Assessment	Has organizational culture and readiness for citiverse digital transformation been evaluated?			
D2-2	Procurement Agility	Are procurement processes adapted to efficiently and flexibly acquire technology, especially for citiverse initiatives, while respecting mandated regulatory oversight?			
D2-3	Legacy System Integration	Are existing systems integrated with new citiverse infrastructure?			
D2-4	Societal Readiness Levels	Has the local community demonstrated readiness to adopt and adapt to citiverse technologies?			
D2-5	Public Trust	Are citizen trust, online safety and misinformation mitigation strategies embedded into citiverse governance and strategy?			
D2-6	Partnership Governance	Are partnership frameworks established with clear roles and consensus-building mechanisms for stakeholder alignment?			
D2-7	Multilateral and Multilevel Governments Collaborations	Are you working with or plan to work with other local, regional, national, supranational governments on citiverse implementation?			

4.3 Domain 3: Use Cases Pipeline

4.3.1 Use Case Pipeline & Implementation

D3-1 R&D Capacity

Are research and development capabilities established for citiverse innovation?

a) The city has no internal R&D capacity for citiverse technologies.

b) R&D is outsourced entirely to vendors or academic partners on a project basis.

c) A small internal R&D team or function has been established to explore and prototype use cases.

d) A dedicated citiverse R&D lab exists with a budget, mandate, and partnerships to develop new applications.

e) The R&D lab operates as an open innovation hub, attracting top talent and co-creating use cases with citizens and startups, in partnership with local universities and private sector firms, with a pipeline of patented solutions.

D3-2 Innovation Pipeline

Is there a structured approach to identifying and developing new citiverse applications?

a) New applications are identified opportunistically, with no structured pipeline.

b) A simple “ideas mailbox” exists, but there is no process for evaluation or development.

c) A stage-gate process for evaluating, prioritizing and funding new use cases is being designed.

d) A managed innovation pipeline is operational, with a portfolio of projects at different maturity levels (ideation, PoC, scaling).
e) The pipeline is fed by predictive analytics and citizen demand signals, ensuring resources are focused on the highest-impact and most viable use cases.

D3-3 Evidence-based Scaling
Are pilot project results systematically evaluated before scaling?
a) Pilots are scaled based on subjective success criteria or political pressure.
b) Basic metrics are collected, but no formal evaluation framework is used to make scaling decisions.
c) A standardized pilot evaluation framework is being developed, including cost-benefit analysis.
d) All pilots undergo a rigorous, independent review against predefined success metrics before a go/no-go decision for scaling.
e) A "scale-up readiness" index is used, assessing not just technical success but also operational, financial, and societal readiness before full deployment.

4.3.2 Long-term Impact Goals

D3-4 Future of Work
Will citiverse deployment create new jobs and industries in our city – and can targeted policies accelerate local economic development?
a) Job creation is not a stated goal of the citiverse initiative.
b) The potential for job creation is acknowledged but not quantified or actively pursued.
c) An economic impact study is underway to forecast new job categories and business opportunities.
d) Workforce development programmes and SME support funds are explicitly tied to citiverse ecosystem growth.
e) The city has a proven track record of spawning citiverse-native companies and jobs, with a vibrant local ecosystem supported by targeted policies (e.g., tax incentives, startup incubators).

D3-5 Quality Life and Health Span
Does the technical architecture and application layer of the citiverse ecosystem – including its data models, interoperability standards, and user interfaces – actively enable, or inadvertently hinder, the development and use of human virtual twins to equitably improve outcomes of health and wellbeing, quality of life, and health span for all citizens, with specific consideration for varying needs across gender and age?
a) The architecture is generic and not designed with health or human virtual twin applications in mind.
b) The potential is recognized, but architecture decisions are made without specific consideration for health equity.
c) Requirements for health data integration and ethical virtual twin use are being incorporated into architectural standards.
d) The citiverse platform has built-in capabilities (e.g., secure health data APIs, inclusive UI frameworks) that actively enable approved health and wellness applications.
e) The city's citiverse is a testbed for preventative health, with partnerships with research institutions using citizen-controlled virtual twins to personalize and improve health outcomes

across all demographics.

D3-6 Circular Economy

Are there plans to leverage citiverse to boost stakeholder engagement in advancing circular economy practices across all city operations?

a) The citiverse and circular economy initiatives are completely separate.

b) There is conceptual interest in using immersive simulations for education about circular economy.

c) Specific use cases are being prototyped, such as digital product passports or virtual recycling guides.

d) The citiverse is used to optimize city operations for circularity (e.g., simulating reverse logistics, virtual material marketplaces).

e) The citiverse enables a city-wide "circular economy dashboard", engaging citizens and businesses in a closed-loop system where virtual tracking and incentives drive real-world sustainable behaviour.

D3-7 Nature-Based and Energy Efficient Solutions(NBS):

Are Nature-Based and Energy Efficient Solutions (NBS) within our citiverse initiatives effectively leveraged to address critical urban challenges – including climate resilience, water/food security, and disaster risk reduction – while ensuring measurable benefits for citizens and biodiversity?

a) Citiverse and NBS initiatives are planned and implemented in separate silos.

b) The potential for using digital twins to model NBS is under discussion.

c) Pilot projects are using the citiverse to visualize and simulate the impact of proposed NBS (e.g., new parks, green roofs).

d) The citiverse is integrated with IoT sensors in natural assets, providing real-time data on biodiversity and ecosystem services for management.

e) The citiverse serves as a collaborative platform for co-designing NBS with communities, modelling their multidecade benefits, and monitoring their real-world performance against climate and biodiversity goals.

D3-8 Climate Resilience

Are climate change adaptation measures comprehensively integrated into citiverse planning, implementation, and governance to ensure the long-term resilience of urban infrastructure against extreme weather events and gradual climatic shifts?

a) Climate change adaptation and citiverse planning are managed separately with no formal integration points.

b) Initial discussions are underway regarding using the citiverse to visualize existing climate hazards (e.g., current flood maps).

c) Pilot projects use the citiverse to model the impact of specific, proposed adaptation measures (e.g., changes to drainage systems, sea wall heights) in defined zones.

d) Climate adaptation is a formal requirement for all major citiverse infrastructure planning, utilizing the digital twin to simulate and test a range of future climate scenarios against key assets and services.

e) The citiverse acts as a dynamic, predictive platform that continuously integrates real-time climate data, monitors the performance of adaptation strategies, and actively supports evidence-based, adaptive policy changes to maximize long-term urban resilience.

Table 5 Domain 3: Use Cases Pipeline

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D3-1	R&D Capacity	Are research and development capabilities established for citiverse innovation?			
D3-2	Innovation Pipeline	Is there a structured approach to identifying and developing new citiverse applications?			
D3-3	Evidence-based Scaling	Are pilot project results systematically evaluated before scaling?			
D3-4	Future of Work	Will citiverse deployment create new jobs and industries in our city – and can targeted policies accelerate local economic development?			
D3-5	Quality Life and Health Span	Does the technical architecture and application layer of the citiverse ecosystem – including its data models, interoperability standards, and user interfaces – actively enable, or inadvertently hinder, the development and use of human virtual twins to equitably improve health outcomes, quality of life, and health span for all citizens, with specific consideration for varying needs across gender and age?			
D3-6	Circular Economy	Are there plans to leverage citiverse to boost stakeholder engagement in advancing circular economy practices across all city operations?			
D3-7	Nature-Based and Energy Efficient Solutions (NBS):	Are we effectively leveraging Nature-Based and Energy Efficient Solutions (NBS) within our citiverse initiatives to address critical urban challenges – including climate resilience, water/food security, and disaster risk reduction – while ensuring measurable benefits for citizens and biodiversity?			
D3-8	Climate Resilience	Are climate change adaptation measures comprehensively integrated into citiverse planning, implementation, and governance to ensure the long-term resilience of urban infrastructure against extreme weather events and gradual climatic shifts?			

4.4 Domain 4: Governance and Regulations

4.4.1 Legal & Regulatory Framework

D4-1 CRPD Alignment

Is the development and governance of the citiverse explicitly aligned with the principles and

articles of the United Nations Convention on the Rights of Persons with Disabilities (CRPD), ensuring non-discrimination, accessibility, and full participation for persons with disabilities?
a) CRPD alignment is not a consideration in citiverse development.
b) The relevance of CRPD is acknowledged, but no specific actions have been taken.
c) A gap analysis is being conducted to assess current citiverse plans against CRPD principles.
d) Citiverse governance documents and procurement standards explicitly reference and require compliance with CRPD.
e) The city is a global exemplar, with persons with disabilities actively co-designing the citiverse, and its compliance with CRPD is regularly audited and publicly reported.

D4-2 Legal Framework Compliance
Are legal frameworks updated to address virtual world governance issues such as legal status and liability of avatars?
a) Existing laws and regulations have not been reviewed for applicability to the citiverse.
b) The legal ambiguities are known, but no formal review process has been initiated.
c) A cross-departmental task force has been convened to identify necessary legal and regulatory updates.
d) Specific ordinances or regulations have been passed to clarify issues like digital asset ownership, avatar liability and virtual crime.
e) The city has a proactive "regulatory sandbox" to test new legal approaches for the citiverse, informing national and international policy.

D4-3 Intellectual Property Management
Are IP policies established for citiverse developments and partnerships?
a) There is no specific IP policy, leading to ambiguity in partnerships.
b) A standard city-wide IP policy is applied, but it is not well-suited to collaborative digital innovation.
c) A draft IP policy tailored for citiverse co-creation is under negotiation with legal and partner stakeholders.
d) A clear IP framework is in place, defining ownership, licensing, and revenue-sharing for city-led and partnered developments.
e) The IP strategy is used to stimulate innovation, with a default preference for open-source or fair licensing of non-critical code, while strategically protecting key city assets.

D4-4 Human Rights & Enforcement
Are there safeguards against harm and discrimination (particularly for vulnerable users such as children, ethnic minorities, women), as well as accountability protocols and law-enforcement tools for citiverse-specific risks?
a) No specific safeguards or enforcement protocols exist for the citiverse.
b) General online safety principles are referenced, but no tailored measures are in place.
c) A comprehensive policy document outlining rights, safeguards, and reporting mechanisms is being drafted.
d) Legally enforceable codes of conduct, age verification tools, and dedicated reporting/response protocols are operational.
e) The city collaborates with law enforcement on specialized training for virtual crimes, and its safeguards are continuously stress-tested and updated based on incident data.

D4-5 Regulatory Compliance Risk
Are legal and regulatory compliance risks regularly reviewed and updated?
a) Compliance risks are not formally tracked for citiverse initiatives.
b) A one-time initial legal review was conducted, but it is not updated.
c) A register of key compliance risks (e.g., data privacy, accessibility) is maintained and reviewed annually.
d) Compliance risks are integrated into the enterprise risk management framework and reviewed quarterly.
e) Automated regulatory monitoring tools track changes in relevant laws, and the compliance register updates dynamically, with mitigation actions assigned automatically.

4.4.2 Ethical Oversight & Policy

D4-6 Digital Ethics Committee
Is there a multistakeholder ethics committee for reviewing citiverse projects to ensure all ethics policies (such as digital inclusion policies) are effectively implemented?
a) There is no ethics committee or review process for citiverse projects.
b) An existing, general technology ethics group may review projects if asked.
c) A charter for a dedicated citiverse Digital Ethics Committee has been drafted and members are being recruited.
d) A standing Ethics Committee with external experts and community representatives actively reviews all major citiverse projects.
e) The Ethics Committee has a "red team" function, conducting pre-emptive audits of systems, and its recommendations are binding for project continuation.

D4-7 Ethical AI & Immersion Policy
Do adopted guidelines cover bias, discrimination, accessibility, explainability, transparency and psychological impacts and detection of immersive and AI tech?
a) No specific ethical guidelines for AI or immersion have been adopted.
b) High-level principles exist but lack actionable details for project teams.
c) Detailed draft guidelines are undergoing internal consultation and pilot testing.
d) Formally adopted guidelines are mandatory for all projects, supported by checklists and impact assessment tools.
e) Ethical AI and immersion are core requirements in procurement and design, with automated tools scanning for bias and systems certified against the city's ethical standard.

D4-8 Algorithmic Transparency
Are AI systems in the citiverse designed to be explainable, accountable, and participatory, with mechanisms for citizens to understand and challenge automated decisions as recommended by the EU AI Act, UNESCO's Recommendation on AI Ethics?
a) AI systems are "black boxes" with no transparency or appeal mechanisms.
b) Providers are asked about explainability, but it is not a mandatory requirement.
c) A policy requiring explainable AI (XAI) and citizen appeal processes is being developed.
d) All deployed AI systems include public-facing "model cards" and a clear process for citizens to request explanations and challenge outcomes.
e) The city uses a "citizen jury" model for reviewing high-impact algorithms, and the source code

for non-sensitive AI is open for public audit.

D4-9 Ethical Oversight Committee
Is there a multidisciplinary ethical oversight committee that reviews data practices and AI deployments from human rights and fairness perspectives?
a) No dedicated ethical oversight exists for data and AI.
b) Ethical questions are addressed ad hoc by project legal teams.
c) A proposal for a standing Data & AI Ethics Review Board has been submitted to leadership.
d) A multidisciplinary board (e.g., with ethicists, sociologists, community advocates) conducts mandatory reviews of high-risk data and AI projects.
e) The board has the authority to halt projects, its reviews are published (with sensitivities redacted), and it conducts retrospective audits of deployed systems.

D4-10 Accessibility by Default
Does the citiverse initiative have a policy of "accessibility by default", mandating that all products, services and environments are designed to be accessible from the outset, in accordance with the principle of Universal Design, rather than relying on retrofitting or assistive technologies as a primary solution?
a) Accessibility is considered a post-launch feature or a compliance issue.
b) The goal of accessibility is stated, but projects often start without inclusive design.
c) A formal "Accessibility by Default" policy has been drafted and is being socialized across teams.
d) The policy is mandatory, and all procurement RFPs and internal design sprints require proven adherence to Universal Design principles.
e) The city's citiverse environment is recognized as a benchmark for accessibility, with continuous user testing involving people with disabilities throughout the development lifecycle.

D4-11 Data Governance Framework
Is there an established, strategically aligned data governance framework defining the structures, policies and standards necessary to manage citiverse data for ethical use, quality and interoperability?
a) Data governance is fragmented or non-existent; data management is tactical, lacking a high-level framework linked to the city's normative objectives (e.g., privacy, equity).
b) Basic data management policies exist (e.g., simple classification), but there is no overarching Data Governance Framework defining stewardship, technical standards (e.g., metadata, quality), or rules for cross-departmental sharing.
c) A formal Data Governance Framework is under development, clearly articulating the strategic intent and defining roles, responsibilities, and preliminary policies for data ethics, privacy, and access control for citiverse data.
d) A formal Data Governance Framework is approved and implemented. It mandates clear technical standards (e.g., metadata, quality, interoperability) for data repositories and enforces policies covering ownership, lifecycle, and ethical compliance across the entire citiverse data landscape.
e) Data governance is embedded and automated; policy enforcement is built into the citiverse data platform, ensuring data is a secure, discoverable, and reusable asset that meets the highest standards for technical compliance, transparency, and ethical use (e.g., privacy-preserving data techniques).

D4-12 Digital Rights and Human Oversight

Does the citiverse initiative enforce comprehensive policies to safeguard citizens' digital rights – including freedom of expression in virtual spaces, guaranteed accessibility for disabled users, affordable connectivity/device access programmes, options for regional data storage, and human oversight with appeal mechanisms for AI-driven decisions – while ensuring these protections are technically implemented and publicly accountable?

a) Digital rights are not formally addressed in citiverse governance.

b) A list of aspirational digital rights principles has been published but not enforced.

c) A detailed Digital Rights Charter is being co-created with citizens and civil society groups.

d) The Digital Rights Charter is legally embedded in all vendor contracts and platform rules, with a dedicated ombudsperson for enforcement.

e) The city publishes an annual "State of Digital Rights" report, and its technical implementation of these rights is independently verified and used as a model for other cities.

D4-13 Democratic Accountability and Oversight

Are there transparent mechanisms for democratic oversight of the citiverse by elected officials (e.g., council committees), ensuring that major strategic decisions are subject to public scrutiny and debate?

a) Citiverse decisions are made by the executive branch with minimal council oversight.

b) Council is briefed infrequently on high-level progress, but not on strategic decisions.

c) A specific council sub-committee has been proposed to provide oversight for digital transformation.

d) A standing committee of elected officials regularly reviews citiverse strategy, budget, and major contracts, with public sessions.

e) The council committee has subpoena power, commissions its own independent reviews, and all non-sensitive briefing materials are published proactively.

D4-14 Digital Rights and Human Oversight

Does the citiverse initiative enforce comprehensive policies to safeguard citizens' digital rights – including freedom of expression in virtual spaces, guaranteed accessibility for disabled users, affordable connectivity/device access programmes, options for regional data storage, and human oversight with appeal mechanisms for AI-driven decisions – while ensuring these protections are technically implemented and publicly accountable?

a) No specific policies or technical mechanisms are in place to address digital rights, human oversight, or equity concerns within the citiverse.

b) High-level commitments to digital rights are included in foundational documents, but they lack technical implementation details and dedicated resources for enforcement.

c) Specific policies are established for guaranteed accessibility and human review of high-impact AI decisions, with an initial, limited programme for affordable connectivity.

d) Comprehensive policies are technically implemented across the citiverse, covering freedom of expression, data storage options, accessibility standards, and a formal human appeal mechanism for all adverse automated decisions.

e) The entire framework of digital rights, human oversight, and equitable access is publicly audited and transparently accountable, with citizen-led governance structures empowered to enforce policy and directly influence the design of the citiverse to maximize digital equity and democratic rights.

Table 6 Domain 4: Governance and Regulations

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D4-1	CRPD Alignment	Is the development and governance of the citiverse explicitly aligned with the principles and articles of the United Nations Convention on the Rights of Persons with Disabilities (CRPD), ensuring non-discrimination, accessibility, and full participation for persons with disabilities?			
D4-2	Legal Framework Compliance	Are legal frameworks updated to address virtual world governance issues such as legal status and liability of avatars?			
D4-3	Intellectual Property Management	Are IP policies established for citiverse developments and partnerships?			
D4-4	Human Rights & Enforcement	Are there safeguards against harm and discrimination (particularly for vulnerable users such as children, ethnic minorities, women), as well as accountability protocols and law-enforcement tools for citiverse-specific risks?			
D4-5	Regulatory Compliance Risk	Are legal and regulatory compliance risks regularly reviewed and updated?			
D4-6	Digital Ethics Committee	Is there a multi-stakeholder ethics committee for reviewing citiverse projects to ensure all ethics policies (such as digital inclusion policies) are effectively implemented?			
D4-7	Ethical AI & Immersion Policy	Do adopted guidelines cover bias, discrimination, accessibility, explainability, transparency, and psychological impacts and detection of immersive and AI tech?			
D4-8	Algorithmic Transparency	Are AI systems in the citiverse designed to be explainable, accountable and participatory, with mechanisms for citizens to understand and challenge automated decisions as recommended by the EU AI Act, UNESCO's Recommendation on AI Ethics?			
D4-9	Ethical Oversight Committee	Is there a multidisciplinary ethical oversight committee that reviews data practices and AI deployments from human rights and fairness perspectives?			
D4-10	Accessibility by Default	Does the citiverse initiative have a policy of "accessibility by default", mandating that all products, services, and environments are designed to be accessible from the outset, in accordance with the principle of Universal Design, rather than relying on retrofitting or assistive technologies as a			

		primary solution?			
D4-11	Data Governance Framework	Is there an established, strategically aligned data governance framework defining the structures, policies, and standards necessary to manage citiverse data for ethical use, quality and interoperability?			
D4-12	Digital Rights and Human Oversight	Does the citiverse initiative enforce comprehensive policies to safeguard citizens' digital rights – including freedom of expression in virtual spaces, guaranteed accessibility for disabled users, affordable connectivity/device access programmes, options for regional data storage, and human oversight with appeal mechanisms for AI-driven decisions – while ensuring these protections are technically implemented and publicly accountable?			
D4-13	Democratic Accountability and Oversight	Are there transparent mechanisms for democratic oversight of the citiverse by elected officials (e.g., council committees), ensuring that major strategic decisions are subject to public scrutiny and debate?			
D4-14	Digital Rights and Human Oversight	Does the citiverse initiative enforce comprehensive policies to safeguard citizens' digital rights – including freedom of expression in virtual spaces, guaranteed accessibility for disabled users, affordable connectivity/device access programmes, options for regional data storage, and human oversight with appeal mechanisms for AI-driven decisions – while ensuring these protections are technically implemented and publicly accountable?			

4.5 Domain 5: Technology Infrastructure

4.5.1 Foundational Infrastructure

D5-1 Data Management Capacity & Investment

Is there an explicit, funded plan and dedicated personnel allocated to the full data lifecycle management (collection, cleaning, storage, security and retirement) required to sustain the citiverse?

a) Data management activities are unfunded and performed ad hoc by existing staff; there is no formal recognition that data governance efforts require dedicated resources.

b) Data preparation and cleaning efforts for initial pilot projects are recognized, but project funding does not include provisions for long-term data curation, storage, or security across the citiverse lifecycle.

c) A formal assessment has quantified the technical, financial, and human resource needs for data governance and management; a multi-year funding proposal for these activities is awaiting approval.

d) Dedicated data stewardship and engineering teams are funded and operating, ensuring the sustained quality and security of citiverse data; costs for governance elements are explicitly integrated into the city's annual IT budget.
e) Data management is optimized and highly automated (e.g., automated data ingestion, quality checks, self-service governance tools), demonstrating cost-efficiency and providing a dedicated, skilled workforce focused on innovation and data utilization.

D5-2 Computing Capacity

Does the existing computing infrastructure meet the minimum technical requirements to support citiverse's core operations – including edge computing nodes, high-performance processing, and future quantum readiness?
a) Current infrastructure is insufficient for basic citiverse applications.
b) Infrastructure can support small-scale pilots but not city-wide deployment.
c) A plan to upgrade computing capacity (cloud, edge, HPC) is funded and being executed.
d) A resilient, scalable computing fabric is in place, capable of handling current and projected citiverse loads.
e) The infrastructure is "future-proofed," with partnerships for quantum computing access and AI-optimized hardware, positioning the city as a leader in urban compute capacity.

D5-3 Network Connectivity

Is high-speed, low-latency network infrastructure available city-wide?
a) Network connectivity is inconsistent and insufficient for immersive applications.
b) High-speed connectivity is available in central business districts but not city-wide.
c) A major public-private partnership is underway to deploy fibre and 5G/Wi-Fi 6E to all neighbourhoods.
d) Robust, affordable, low-latency connectivity is available as a public utility to more than 95 per cent of households and businesses.
e) The city operates a seamless, integrated wireless-mesh-fibre network that provides guaranteed service levels for critical citiverse applications.

4.5.2 Core Technologies

D5-4 Multimodal and Immersive Data Platform Integration

Do modern data platforms possess the architectural capabilities to seamlessly integrate multimodal sensory inputs, immersive environment data streams, and AI processing pipelines at enterprise scale?
a) The data platform is designed for traditional structured data, not multimodal or immersive streams.
b) Experimental projects are handling multimodal data, but not on a centralized, scalable platform.
c) A next-generation data platform capable of handling 3D, video, LiDAR, and IoT data is being procured or built.
d) A unified data platform ingests, processes, and serves multimodal data to authorized citiverse applications in real-time.
e) The platform features built-in AI services for analysing complex data streams (e.g., computer vision), enabling proactive and immersive city services.

D5-5 AI Architecture

Does the AI processing layer employ modular microservices and federated learning to enable secure, distributed prediction/prescription across urban systems while maintaining interoperability?
a) AI is applied in monolithic, application-specific silos.
b) Some microservices are used, but the architecture is not designed for federated learning or cross-system interoperability.
c) A reference architecture for a modular, microservices-based AI layer is being designed.
d) A central AI-as-a-Service platform provides reusable microservices for common tasks, and federated learning pilots are underway for privacy-sensitive data.
e) The AI fabric is fully decentralized, allowing models to be trained securely across departments and partner organizations without sharing raw data, maximizing insight and privacy.

D5-6 Digital Twin Architecture
Are digital twin systems implemented with real-time data and simulation integration capabilities?
a) The city does not have a digital twin.
b) Static 3D models exist for visualization, but they lack real-time data integration.
c) A live digital twin is in development, with pilots connecting real-time data feeds for specific districts or services.
d) A city-scale digital twin is operational, integrating IoT, BIM, and GIS data for simulation and analysis.
e) The digital twin is a predictive "what-if" machine, used to autonomously optimize city operations and test policies in a risk-free virtual environment before implementation.

4.5.3 Standards & Interoperability

D5-7 Standards Organizations Engagement
Does your organization engage with standards bodies and apply existing national and international technical standards in the development and governance of citiverse infrastructure?
a) The city does not participate in standards bodies and uses proprietary solutions.
b) The city follows dominant de-facto standards but does not actively engage in their development.
c) City staff monitor relevant standards bodies (e.g., ITU) and aim to adopt open standards where possible.
d) The city is a voting member in key standards organizations, influencing specifications for urban digital twins and metaverses.
e) The city leads or co-chairs working groups in standards bodies, and its citiverse implementation is a reference site for interoperable urban technology.

D5-8 Interoperability Standards
Are open standards and APIs implemented for system integration?
a) Systems use proprietary interfaces, making integration difficult and costly.
b) Some internal APIs exist, but they are not based on open standards.
c) A mandate to use open standards and APIs for all new citiverse systems has been issued.
d) A city-wide API catalogue exists, and all major systems expose well-documented, standards-based APIs.
e) Interoperability is a feature, not an afterthought; the city's systems can "plug and play" with systems from other municipalities and vendors with minimal friction.

D5-9 W3C Accessibility Standards Adoption

Are the core accessibility standards from the World Wide Web Consortium (W3C) – namely the Web Content Accessibility Guidelines (WCAG), Authoring Tool Accessibility Guidelines (ATAG), and User Agent Accessibility Guidelines (UAAG) – adopted as a baseline for all web-based, application-based, and content creation tools within the citiverse?

a) W3C standards are not a mandatory requirement for citiverse projects.

b) WCAG is referenced for public websites, but not consistently enforced for applications or immersive environments.

c) A policy is being drafted to mandate WCAG, ATAG, and UAAG compliance for all relevant citiverse components.

d) Compliance with the latest W3C accessibility standards is a mandatory gate in all procurement and development lifecycles.

e) The city contributes to the evolution of W3C standards, particularly for XR, and its compliance testing tools are shared with the open-source community.

D5-10 Interoperability Planning

Are systems designed for future integration and scalability?

a) Systems are designed to meet immediate project needs with no long-term interoperability plan.

b) Scalability is considered, but interoperability with future unknown systems is not.

c) Architectural principles emphasizing loose coupling and API-first design are being adopted.

d) All new systems require an "interoperability and scalability assessment" as part of the design phase.

e) The city's technology stack is composable, allowing new services to be assembled from reusable, interoperable components, dramatically reducing time-to-market for new citiverse applications.

D5-11 Replicability and Adoption

Are there plans to adopt interoperability standards such as ITU's Minimum Interoperability Mechanisms (MIMs)[8] to enable seamless "plug-and-play" integration between the citiverse platform and other cities' digital ecosystems, thereby accelerating collaborative development?

a) The city's citiverse is a walled garden with no plans for external interoperability.

b) The concept of MIMs is known, but no decision has been made.

c) A feasibility study is underway to assess the cost and benefit of adopting MIMs or similar standards.

d) The city has committed to implementing MIMs or an equivalent open interoperability framework for its core citiverse services.

e) The city is a founding member of a network of cities using a common interoperability standard, enabling shared services, data exchange, and collaborative problem-solving.

D5-12: Vendor Exit Strategies

Is an explicit, formally approved strategy in place for the full exit or switching from major citiverse platform vendors, and is it a mandatory component of all platform procurement decisions?

a) No formal exit strategy exists; the city relies on the vendor's standard contract terms.

b) The need for an exit strategy is discussed, and general principles (e.g., using open-source) are encouraged.

c) A draft formal strategy is under review, outlining procedures for data migration and system hand-over.

d) An approved, explicit vendor exit strategy is a mandatory, scored component in all major citiverse platform RFPs and is regularly reviewed.
e) The exit strategy is actively tested (e.g., through periodic data migration drills), demonstrating a proven capability to switch providers with minimal service disruption and cost.

D5-13: Contractual Exit Clauses
Do all major citiverse platform and infrastructure contracts include specific, non-penalizing exit clauses that define timelines, responsibilities, and the level of vendor support for a transition to an alternative provider?
a) Contracts contain only standard termination clauses with no specific provisions for vendor support during a switch.
b) Contracts include a basic requirement for data handover but lack detailed timelines or defined support obligations.
c) Contracts mandate specific vendor support (e.g., dedicated staff, clear timelines) for a defined transition period after termination.
d) Contracts include non-penalizing, detailed exit clauses that specify all vendor obligations, proprietary information escrow, and agreed-upon costs (or zero cost) for transition services.
e) The city leverages its contractual power to standardize these robust exit clauses across all major technology agreements, setting a market-leading benchmark.

D5-14: Data Portability Requirements
Are clear, legally-binding data portability requirements enforced, mandating that all citiverse data (including non-personal data, models, and metadata) must be exportable in an open, machine-readable format with associated documentation upon contract termination?
a) Data are often locked in proprietary formats with no guaranteed export method.
b) Contracts require data export, but the format may not retain full functionality or metadata.
c) Contracts explicitly mandate that data be portable in a common, structured format that preserves key relationships and metadata.
d) All citiverse data, including digital twin models and application configurations, are required to be exportable in a non-proprietary, open, machine-readable format that enables functional equivalence on a competitor's platform.
e) The city publishes its data portability specifications and tools as open source, actively assisting other public sector entities in achieving similar data autonomy.

D5-15: Total Cost of Switching Assessment
Is a Total Cost of Switching analysis a required component of all major citiverse platform procurement business cases, explicitly calculating the costs associated with data migration, system re-integration, and staff retraining?
a) No formal assessment of switching costs is performed during procurement.
b) Procurement includes a qualitative risk assessment that briefly mentions potential switching difficulties.
c) The business case requires a basic estimate of data migration and re-integration labour costs.
d) A formal Total Cost of Switching analysis is mandatory, explicitly calculating all technical (migration, re-integration), operational (downtime, staff training), and commercial (exit fees, legacy system maintenance) costs for a three-year window.

e) The Total Cost of Switching assessment is benchmarked against the initial total cost of ownership to ensure the cost-to-benefit ratio of the chosen solution, including future flexibility, justifies the lock-in risk.

4.5.4 Scalability & Viability

D5-16 Long-term Viability
Are sustainability assessments conducted for technology investments?
a) Technology investments are approved based on initial cost and features only.
b) Total Cost of Ownership is calculated, but not broader sustainability (environmental, social).
c) A framework for technology sustainability assessments (economic, environmental, social) is being developed.
d) All major citiverse technology investments undergo a mandatory sustainability assessment before approval.
e) The sustainability assessment is a key decision tool, and its findings are used to create a circular economy plan for the technology's entire lifecycle.

Table 7 Domain 5: Technology Infrastructure

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D5-1	Data Management Capacity & Investment	Is there an explicit, funded plan and dedicated personnel allocated to the full data lifecycle management (collection, cleaning, storage, security, and retirement) required to sustain the citiverse?			
D5-2	Computing Capacity	Does the existing computing infrastructure meet the minimum technical requirements to support citiverse's core operations – including edge computing nodes, high-performance processing, and future quantum readiness?			
D5-3	Network Connectivity	Is high-speed, low-latency network infrastructure available city-wide?			
D5-4	Multimodal and Immersive Data Platform Integration	Do modern data platforms possess the architectural capabilities to seamlessly integrate multimodal sensory inputs, immersive environment data streams, and AI processing pipelines at enterprise scale?			
D5-5	AI Architecture	Does the AI processing layer employ modular microservices and federated learning to enable secure, distributed prediction/prescription across urban systems while maintaining interoperability?			
D5-6	Digital Twin Architecture	Are digital twin systems implemented with real-time data and simulation integration capabilities?			

D5-7	Standards Organizations Engagement	Does your organization engage with standards bodies and apply existing national and international technical standards in the development and governance of citiverse infrastructure?			
D5-8	Interoperability Standards	Are open standards and APIs implemented for system integration?			
D5-9	W3C Accessibility Standards Adoption	Are the core accessibility standards from the World Wide Web Consortium (W3C) – namely the Web Content Accessibility Guidelines (WCAG), Authoring Tool Accessibility Guidelines (ATAG), and User Agent Accessibility Guidelines (UAAG) – adopted as a baseline for all web-based, application-based, and content creation tools within the citiverse?			
D5-10	Interoperability Planning	Are systems designed for future integration and scalability?			
D5-11	Replicability and Adoption	Are there plans to adopt interoperability standards such as ITU's Minimum Interoperability Mechanisms (MIMs) to enable seamless “plug-and-play” integration between the citiverse platform and other cities' digital ecosystems, thereby accelerating collaborative development?			
D5-12	Vendor Exit Strategies	Is an explicit, formally approved strategy in place for the full exit or switching from major citiverse platform vendors, and is it a mandatory component of all platform procurement decisions?			
D5-13	Contractual Exit Clauses	Do all major citiverse platform and infrastructure contracts include specific, non-penalizing exit clauses that define timelines, responsibilities, and the level of vendor support for a transition to an alternative provider?			
D5-14	Data Portability Requirements	Are clear, legally-binding data portability requirements enforced, mandating that all citiverse data (including non-personal data, models, and metadata) must be exportable in an open, machine-readable format with associated documentation upon contract termination?			
D5-15	Total Cost of Switching Assessment	Is a Total Cost of Switching analysis a required component of all major citiverse platform procurement business cases, explicitly calculating the costs associated with data migration, system re-integration, and staff retraining?			
D5-16	Long-term Viability	Are sustainability assessments conducted for technology investments?			

4.6 Domain 6: Data Privacy and Protection

4.6.1 Data Management

D6-1 Data Capture Ecosystem
Is there an effective data capturing ecosystem that includes all digital devices to capture, manage and optimise all data such as from IOT, sensors, cameras, activators, devices?
a) Data capture is siloed, with no integrated ecosystem.
b) A limited number of city-owned sensors exist, but data is not centrally managed.
c) A city IoT strategy and platform are being implemented to unify data ingestion from various devices.
d) A mature data capture ecosystem exists, integrating streams from city assets, partners, and citizen-contributed data (with consent).
e) The ecosystem is adaptive, using AI to optimize sensor placement and data collection based on real-time needs, minimizing cost and maximizing value.

D6-2 Data Space
Is there an effective, ethical, secure, legal governance, contract, and a technical connector to enable data sharing between different parties and stakeholders to support decision making?
a) There is no formal data sharing framework; data is shared through bilateral, ad hoc agreements.
b) Standard Data Sharing Agreements exist but are slow to negotiate and lack technical connectors.
c) A city data space initiative is in the design phase, based on models like International Data Spaces.
d) An operational data space is available, providing a trusted environment with standardized legal and technical tools for secure data sovereignty.
e) The data space is a vibrant marketplace of data and services, enabling novel public-private-civic collaborations that drive innovation in the citiverse and beyond.

4.6.2 Data Rights & Protection

D6-3 Data Privacy
Are robust citizen-centric privacy, consent, and data sovereignty mechanisms integrated into all citiverse services?
a) Privacy is an afterthought, with terms of service that are difficult to understand.
b) Basic privacy notices exist, but consent mechanisms are often “take-it-or-leave-it.”
c) A "Privacy by Design" framework is being implemented, requiring granular consent options and data minimization.
d) Citizens have a personalized data dashboard to see what is collected, control its use, and grant/revoke consent easily.
e) The city uses privacy-enhancing technologies like differential privacy and homomorphic encryption by default, giving citizens technical guarantees of their data sovereignty.

D6-4 Cybersecurity Framework
Are robust cybersecurity measures implemented for citiverse systems, including secure-by-design or safe-by-design principles to address vulnerabilities like AI-generated deepfakes?
a) Cybersecurity is reactive, addressed after systems are built and vulnerabilities are found.
b) Basic IT security standards are applied, but they are not tailored to the unique risks of immersive environments.

c) A citiverse-specific cybersecurity framework, including threats like deepfakes and avatar impersonation, is being developed.
d) A "secure-by-design" mandate is enforced, with penetration testing and red teaming required before any citiverse service launch.
e) The city operates a dedicated Cyber Defence Centre for its digital infrastructure, using AI to detect and respond to novel citiverse threats in real-time.

Table 8 Domain 6: Data Privacy and Protection

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D6-1	Data Capture Ecosystem	Is there an effective data capturing ecosystem which includes all digital devices to capture, manage and optimise all data such as from IOT, sensors, cameras, activators, devices?			
D6-2	Data Space	Is there an effective, ethical, secure, legal governance, contract, and a technical connector to enable data sharing between different parties and stakeholders to support decision making?			
D6-3	Data Privacy	Are robust citizen-centric privacy, consent, and data sovereignty mechanisms integrated into all citiverse services?			
D6-4	Cybersecurity Framework	Are robust cybersecurity measures implemented for citiverse systems, including secure-by-design or safe-by-design principles to address vulnerabilities like AI-generated deepfakes?			

4.7 Domain 7: Security and Resilience

4.7.1 Risk Assessment & Management

D7-1 Integrated Risk Register
Has the city compiled a single, regularly updated register covering safety, privacy, operational, financial, and reputational risks for citiverse initiatives?
a) There is no centralized risk register for citiverse initiatives.
b) Individual projects maintain their own risk lists, but they are not consolidated.
c) A process to create a consolidated citiverse risk register is underway.
d) An integrated risk register is actively maintained and reviewed by a central governance body.
e) The risk register is dynamic, with risks automatically flagged from project systems and linked to mitigation actions in real-time.

D7-2 Risk Assessment Framework
Is there a standardized methodology for evaluating citiverse project risks including the use of

probability-impact matrices?
a) Risk assessment is informal and qualitative.
b) A standard enterprise risk matrix exists but is not consistently applied to citiverse projects.
c) A tailored risk assessment framework for citiverse, including novel digital risks, is being piloted.
d) The framework is mandatory, and all projects must complete a standardized risk assessment at key stage gates.
e) The framework is AI-augmented, learning from past projects to predict risks and recommend pre-emptive mitigations.

D7-3 Third-party Risk Management
Are vendor and technology partner risks assessed and monitored continuously?
a) Vendor risk is assessed only during procurement and not monitored thereafter.
b) Basic financial and security checks are done, but not for citiverse-specific operational risks.
c) A third-party risk management program for critical technology partners is being developed.
d) Continuous monitoring of key vendors (e.g., security posture, financial health) is in place, with contractual obligations for transparency.
e) The city uses a "digital supply chain" map to visualize interdependencies and model the cascading impact of a vendor failure on citiverse services.

D7-4 Internal Misuse Risk
Are there any mitigation strategy, audit and assurance to prevent the internal misuse of citiverse for the benefits of individual or small groups against public good?
a) There are no specific policies or mechanisms in place to address the risk of internal misuse of citiverse tools or data.
b) Basic non-disclosure agreements and acceptable use policies are established, but there is no specialized audit or monitoring of citiverse operator actions.
c) Role-based access controls and segregation of duties are implemented for critical citiverse functions, with yearly internal audits focusing on high-risk access privileges.
d) Continuous, real-time audit trails and behavioural analytics are employed to monitor citiverse operator activity, specifically flagging anomalies indicative of potential misuse or unauthorized data access.
e) An independent oversight board and assurance programme regularly review all citiverse governance and operations, with publicly transparent metrics demonstrating that internal controls are effectively preventing misuse and ensuring alignment with the public interest.

4.7.2 Cybersecurity & Critical Infrastructure

D7-5 Data Integrity and Trust
Are formal measures and controls in place to ensure the accuracy, reliability, and integrity of data streams feeding the citiverse, thereby establishing trust in its outcomes?
a) Data integrity relies solely on manual checks or data owners; there are no formal, automated processes to detect or flag corrupted, biased, or spoofed data.
b) Basic data quality checks (e.g., checks for missing values, out-of-range data) are implemented, but there is no mechanism to verify the security or authenticity of data sources.
c) Protocols are being implemented to verify data authenticity and non-repudiation (e.g., source identification), and pilot projects use data reconciliation techniques to cross-validate key data streams.

d) Robust data integrity controls are in place, using checksums and audit trails for all critical citiverse data. Automated validation pipelines actively detect and flag technical corruption and potential deliberate data manipulation.
e) The citiverse utilizes advanced techniques (e.g., cryptographic hashing, distributed ledger technology, or AI-driven anomaly detection) to provide verifiable, real-time proof of data integrity, enabling the highest level of public and operational trust.

D7-6 Digital Identity
Does the citiverse digital identity infrastructure demonstrate adequate robustness in terms of security protocols, fraud prevention, system resilience, misuse of likeness, direct impersonation?
a) Digital identity is rudimentary (username/password) and vulnerable to impersonation.
b) Multifactor authentication is available but not mandatory for all services.
c) A plan for a robust, self-sovereign, or verifiable credentials-based digital identity system is being implemented.
d) A secure, privacy-preserving digital identity system is operational, resistant to fraud and misuse of likeness.
e) The digital identity system is interoperable for cross-border use, uses biometric liveness detection, and allows citizens to control exactly what personal data they share in each interaction.

D7-7 Cybersecurity Incident Response Framework
Are comprehensive incident response protocols established for citiverse systems, including digital forensics capabilities, evidence preservation, and coordinated response with law enforcement agencies?
a) There is no specific incident response plan for citiverse cyber incidents.
b) A generic IT incident response plan exists but does not cover immersive environments.
c) A draft citiverse-specific incident response plan is being tested in tabletop exercises.
d) A fully documented and practiced response plan is in place, with clear roles for forensics, communication, and law enforcement coordination.
e) The response framework is integrated with regional and national cyber defence agencies, enabling instantaneous threat intelligence sharing and coordinated countermeasures.

D7-8 Critical Infrastructure Protection
Are cybersecurity measures specifically designed to protect critical infrastructure (energy, water, transportation) from cyber-physical threats in the citiverse environment?
a) Critical infrastructure operators are not involved in citiverse cybersecurity planning.
b) The risk is acknowledged, but no joint protective measures are in place.
c) Collaborative workshops between citiverse teams and infrastructure operators are being held to identify threats.
d) Joint security controls and air-gapped redundancies are implemented for systems that interface with critical infrastructure.
e) The city runs continuous, joint cyber-physical war games with utility providers, creating a unified defence posture for the connected urban ecosystem.

D7-9 Identity Management Security
Does the citiverse identity management system balance user privacy with security requirements, including robust authentication, fraud prevention, and protection against avatar impersonation?

a) The system prioritizes either convenience or security, but not both, and privacy is weak.
b) Standard security practices are used, but they are not tailored to prevent novel avatar-based attacks.
c) A next-generation identity management system designed for the citiverse is in the procurement or development phase.
d) A balanced system is in production, using adaptive authentication and behavioural analytics to detect impersonation without sacrificing privacy.
e) The identity system is decentralized (e.g., blockchain-based), giving users full control while providing irrefutable authentication and audit trails for security.

4.7.3 Crisis Preparedness & Response

D7-10 Crisis Response Protocols
Are emergency response procedures documented and tested for virtual world system failures?
a) There are no specific protocols for citiverse system failures.
b) General IT disaster recovery plans exist, but they do not address virtual world-specific crises.
c) Draft protocols for incidents like server outages or data corruption are being written.
d) Documented and tested protocols exist for technical failures, including public communication strategies.
e) Response is automated where possible; systems can failover seamlessly, and public alerts are triggered automatically based on system health monitoring.

D7-11 Scenario-based Stress Testing
Are digital twin or table-top exercises conducted at least annually to test high-severity scenarios (e.g., mass-simulation failure, cyberbreach)?
a) No stress testing is conducted for citiverse systems.
b) Basic component testing is done, but not full-system scenario testing.
c) Plans are being made for the first city-wide citiverse table-top exercise.
d) Annual table-top exercises involving technical, communications, and policy teams are conducted.
e) Stress testing is continuous and integrated into the development pipeline, using the digital twin to simulate attacks and failures before they can occur in reality.

D7-12 Cyber-Physical Exercise Programme
Are regular cyber-physical crisis exercises conducted involving utilities, emergency responders, and digital infrastructure operators?
a) No combined cyber-physical exercises are conducted.
b) Cyber and physical exercises are conducted separately by different departments.
c) A multiagency cyber-physical exercise is being planned for the first time.
d) Annual cross-domain exercises test response to scenarios like a coordinated hack on power and transportation during a virtual city event.
e) The exercise programme is a benchmark for other cities, with outcomes directly informing infrastructure investment and policy changes.

D7-13 Business Continuity
Are plans for maintaining essential business functions and recovering from disruptions established and regularly tested across key service providers and city departments?
a) No formal, documented plans for maintaining essential business functions or recovering from

disruptions exist.
b) Basic plans for maintaining essential business functions and recovering from disruptions are in place for critical IT systems, but they are not regularly tested or coordinated with service providers.
c) Documented and tested plans for maintaining essential business functions and recovering from disruptions are established for key city departments and primary infrastructure providers, ensuring minimal downtime for essential services.
d) Comprehensive, interconnected plans for maintaining essential business functions and recovering from disruptions are established, regularly tested via simulations, and include service providers, supply chain dependencies, and formal mutual assistance agreements.
e) The entire city and its key partners operate under a unified, integrated framework for maintaining essential business functions and recovering from disruptions, where test results directly inform financial investment, policy, and infrastructure design for continuous service availability.

D7-14 Cognitive Manipulation Risk
Does the citiverse conduct ongoing risk audits to ensure its immersive environments do not manipulate users' thoughts, feelings, or behaviours without explicit, revocable consent – and is this process transparent to participants?
a) No specific assessment or policy exists regarding the potential for cognitive manipulation within the citiverse environment.
b) A high-level policy commits to preventing manipulation, but no formal audits or technical safeguards are currently in place.
c) Internal design reviews check new citiverse features for common manipulative patterns (e.g., dark patterns), and a basic consent mechanism is required for data usage.
d) Independent, ongoing risk audits are regularly conducted to specifically assess and mitigate features that could non-consensually influence user cognition or behaviour, and users are provided with a clear, revocable consent option.
e) The entire framework for managing cognitive risk, including audit findings, mitigation reports, and a list of all potential persuasive features, is made publicly transparent to all participants, with citizens having a formal mechanism to challenge and propose changes.

Table 9 Domain 7: Security & Resilience

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D7-1	Integrated Risk Register	Has the city compiled a single, regularly updated register covering safety, privacy, operational, financial, and reputational risks for citiverse initiatives?			
D7-2	Risk Assessment Framework	Is there a standardized methodology for evaluating citiverse project risks including the use of probability-impact matrices?			
D7-3	Third-party Risk Management	Are vendor and technology partner risks assessed and monitored continuously?			

D7-4	Internal Misuse Risk	Are there any mitigation strategy, audit and assurance to prevent the internal misuse of citiverse for the benefits of individual or small groups against public good?			
D7-5	Data Integrity and Trust	Are formal measures and controls in place to ensure the accuracy, reliability, and integrity of data streams feeding the citiverse, thereby establishing trust in its outcomes?			
D7-6	Digital Identity	Does the citiverse digital identity infrastructure demonstrate adequate robustness in terms of security protocols, fraud prevention, system resilience, misuse of likeness, direct impersonation?			
D7-7	Cybersecurity Incident Response Framework	Are comprehensive incident response protocols established for citiverse systems, including digital forensics capabilities, evidence preservation, and coordinated response with law enforcement agencies?			
D7-8	Critical Infrastructure Protection	Are cybersecurity measures specifically designed to protect critical infrastructure (energy, water, transportation) from cyber-physical threats in the citiverse environment?			
D7-9	Identity Management Security	Does the citiverse identity management system balance user privacy with security requirements, including robust authentication, fraud prevention, and protection against avatar impersonation?			
D7-10	Crisis Response Protocols	Are emergency response procedures documented and tested for virtual world system failures?			
D7-11	Scenario-based Stress Testing	Are digital twin or table-top exercises conducted at least annually to test high-severity scenarios (e.g., mass-simulation failure, cyberbreach)?			
D7-12	Cyber-Physical Exercise Program	Are regular cyber-physical crisis exercises conducted involving utilities, emergency responders, and digital infrastructure operators?			
D7-13	Business Continuity	Are plans for maintaining essential business functions and recovering from disruptions established and regularly tested across key service providers and city departments?			
D7-14	Cognitive Manipulation	Does the citiverse conduct ongoing risk audits to ensure its immersive			

	Risk	environments do not manipulate users' thoughts, feelings, or behaviours without explicit, revocable consent – and is this process transparent to participants?			

4.8 Domain 8: Inclusivity & Accessibility

4.8.1 Accessibility & Universal Design

D8-1 Inclusive User Experience Design

Are inclusive design principles applied to ensure digital and physical accessibility for all citizens, especially people with disabilities?

a) Accessibility is tested at the end of the development process, if at all.

b) Basic compliance checks are done, but not proactive inclusive design.

c) Inclusive design guidelines have been adopted and are being trained out to development teams.

d) Inclusive design is a mandatory phase in all projects, with involvement from users with disabilities throughout.

e) The city's design system is itself inclusive, providing reusable components that are accessible by default, speeding up development and ensuring consistency.

D8-2 Inclusive Design Processes

Are inclusive design processes established to proactively consider and address the needs of people with diverse needs(such as age, and gender) disabilities (including visual, auditory, physical, speech, cognitive, and neurological), as well as those with limited digital literacy or from different linguistic and cultural backgrounds?

a) Design processes focus on the "average" user and do not proactively address diverse needs.

b) Separate "accessibility" and "translation" tasks are added, but not integrated into core design thinking.

c) A formal inclusive design process framework, covering the full spectrum of diversity, is being implemented.

d) Co-design sessions with diverse user groups are a standard and funded part of every project's discovery phase.

e) The city's inclusive design process is publicly documented and shared, making it a model for other municipalities and a source of civic pride.

D8-3 Universal Design Principle Application

Is the principle of Universal Design applied throughout the citiverse development lifecycle to create an environment that can be accessed, understood, and used to the greatest extent possible by all people regardless of their age, gender, ethnicity, ability, or disability?

a) Universal Design is a concept that is referenced but not implemented.

b) It is applied to physical spaces but not consistently to digital citiverse environments.

c) Universal Design is a stated goal, and pilots are underway to apply it to digital-physical hybrid spaces.

d) Universal Design is a mandatory requirement in all citiverse-related procurement and design standards.

e) The city's citiverse is internationally recognized as a model of Universal Design, studied for its seamless and equitable user experience.

4.8.2 Multilingual & Localized Support

D8-4 Localized Content with Multilingual support
Do citiverse services include localized content and multilingual support to ensure community acceptance and accessibility?
a) Services are offered only in the primary official language.
b) Critical information is translated into a few major languages, but not all services or interactive content.
c) A strategy for comprehensive multilingual support, including audio and sign language, is being developed.
d) All public-facing citiverse services are fully available in the city's major languages and are culturally localized.
e) Real-time AI-powered translation and transcription services are built into the platform, making it accessible to speakers of any language and those who are deaf or hard of hearing.

4.8.3 Protection of Vulnerable Groups

D8-5 Vulnerable Group Protection
Are specialized protection measures implemented for vulnerable groups (children, elderly, marginalized communities) including age verification, grooming detection, and accessible reporting mechanisms?
a) No specialized protection measures are in place.
b) General safety rules apply to everyone, but no tailored protections exist.
c) Policies for protecting vulnerable groups are drafted, including requirements for age-appropriate design.
d) Dedicated safe spaces, robust age verification, and easy-to-use reporting tools are implemented for children and other vulnerable users.
e) Protection is proactive; AI monitors for predatory behaviour patterns, and support services (e.g., counselling, legal aid) are integrated directly into the reporting flow.

Table 10 Domain 8: Inclusivity and Accessibility

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D8-1	Inclusive User Experience Design	Are inclusive design principles applied to ensure digital and physical accessibility for all citizens, especially people with disabilities?			
D8-2	Inclusive Design Processes	Are inclusive design processes established to proactively consider and address the needs of people with diverse disabilities (including visual, auditory, physical, speech, cognitive, and neurological), as well as those with limited digital literacy or from different			

		linguistic and cultural backgrounds?			
D8-3	Universal Design Principle Application	Is the principle of Universal Design applied throughout the citiverse development lifecycle to create an environment that can be accessed, understood, and used to the greatest extent possible by all people regardless of their age, gender, ethnicity, ability, or disability?			
D8-4	Localized Content with Multilingual Support	Do citiverse services include localized content and multilingual support to ensure community acceptance and accessibility?			
D8-5	Vulnerable Group Protection	Are specialized protection measures implemented for vulnerable groups (children, elderly, marginalized communities) including age verification, grooming detection, and accessible reporting mechanisms?			

4.9 Domain 9: Human Capital

4.9.1 Skills & Capacity

D9-1 Skills Inventory
Has HR mapped current and required competencies (XR, AI, data ethics, change management) across all departments?
a) No skills inventory for citiverse competencies exists.
b) Department heads have a general idea of gaps, but no centralized mapping.
c) HR is conducting a comprehensive skills gap analysis for key roles affected by the citiverse.
d) A dynamic skills inventory is maintained, identifying current competencies and future needs.
e) The skills inventory is linked to the personalized learning platform, automatically recommending courses to close individual and organizational gaps.

D9-2 Capacity-Building Plan
Is there a funded, time-bound capacity building roadmap and succession strategy to assesses staffing skills, technical knowledge, internal training, and ability to manage changes and sustain immersive or AI-based services?
a) No formal assessment or plan for capacity building exists.
b) A skills gap analysis has been conducted, but no funded plan is in place.
c) A draft capacity-building roadmap with estimated costs has been developed and is seeking approval.
d) A funded, multi-year capacity building plan is being executed, including targeted training, hiring, and knowledge transfer.
e) Capacity building is a continuous process, with a dynamic skills inventory, personalized learning paths, and a clear succession pipeline that ensures long-term sustainability.

D9-3 IT/OT Convergence Expertise
Does the city have specialized expertise in converging information technology and operational

technology systems for secure citiverse implementation?
a) IT and OT departments operate in complete silos.
b) There is informal collaboration, but no dedicated expertise in convergence.
c) A joint IT-OT task force has been created to manage integration projects.
d) Specialized roles (e.g., IT/OT Architect) exist and are filled, with a defined convergence framework.
e) The city has a centre of excellence for cyber-physical systems, and its convergence model is used to train staff from IT and OT domains.

4.9.2 Talent Management & Culture

D9-4 Recruitment Strategy
Are specialized roles defined and recruitment processes established for citiverse talent?
a) The city struggles to define and recruit for emerging tech roles.
b) Existing IT roles are used, with hopes that staff can upskill.
c) New role descriptions (e.g., AR/VR/XR Designer, AI Ethicist) have been drafted and are being approved by HR.
d) A targeted recruitment strategy is in place, including partnerships with universities and competitive compensation packages.
e) The city is a "employer of choice" for digital urbanism talent, with a strong brand that attracts top global candidates.

D9-5 Performance Management
Are job descriptions and performance criteria updated to include citiverse digital transformation competencies?
a) Job descriptions and performance reviews have not been updated to reflect new needs.
b) Managers are encouraged to set digital goals, but it is not formalized.
c) HR is working with departments to update key job descriptions and performance management frameworks.
d) Digital literacy and transformation competencies are formal components of performance reviews for relevant roles.
e) Performance management is adaptive, with goals and competencies updated in real-time based on the evolving needs of the citiverse roadmap.

D9-6 Knowledge Management
Are knowledge-sharing systems established to support citiverse development with best practices and expert guidance?
a) Knowledge is siloed in individuals or teams.
b) Basic file shares are used, but finding expertise is difficult.
c) A pilot for a modern knowledge management platform (e.g., an internal wiki) is underway.
d) A centralized knowledge base with curated best practices, lessons learned, and an expert directory is actively used.
e) The knowledge system uses AI to connect people with relevant expertise and recommend content, fostering a strong culture of collaboration and continuous learning.

D9-7 Employee Engagement
Are staff engagement and feedback mechanisms established for transformation initiatives?

a) Staff are informed of decisions after they are made, with no feedback mechanism.
b) An annual survey includes general questions about transformation, with limited follow-up.
c) Specific pulse surveys and dedicated feedback channels for citiverse initiatives have been set up.
d) Regular, structured feedback sessions (e.g., town halls, design sprints) actively involve staff in shaping the transformation.
e) A continuous feedback loop is embedded in operations, with demonstrated changes to plans and policies based on employee input, leading to high levels of change adoption.

D9-8 Citiverse Human Capital Leadership
Is there a designated executive or unit (reporting to the strategic leadership) responsible for developing the *human capital strategy*—including talent acquisition, upskilling, and change management – necessary to support the citiverse transition?
a) No unit or executive is specifically responsible for the human capital implications of the citiverse; staff training is addressed reactively.
b) HR is informed of citiverse plans and provides standard training programmes, but there is no dedicated talent strategy.
c) A dedicated workstream or executive (e.g., within HR or the transformation office) has been tasked with defining the future skills needed for citiverse development and governance.
d) A formal Human Capital Roadmap for the citiverse is actively being executed, with specific programmes for upskilling current staff, recruiting specialized talent (e.g., XR developers, digital ethnographers), and embedding a culture of digital literacy.
e) The Human Capital Strategy includes a continuous feedback mechanism and a leadership development programme specifically designed to cultivate the new cross-functional leadership and ethical thought processes required for a successful, inclusive citiverse.

D9-9 Future of Work
Where exactly will citiverse deployment create new jobs and industries in our city – and what targeted policies can accelerate this economic growth?
a) No assessment has been conducted on the potential job creation or industry growth resulting from the citiverse initiative.
b) A high-level, qualitative report identifies potential job growth in general IT and data management fields.
c) A formal labour market study is completed, identifying specific, new job roles (e.g., Digital Twin Engineers, Virtual Space Moderators) and potential growth sectors, but targeted policies are still under development.
d) Targeted economic policies (e.g., tax incentives, specialized workforce training programmes, SME incubation) are actively deployed based on the job creation analysis to accelerate growth in defined, citiverse-related industries.
e) The citiverse is used as a dynamic platform to forecast future labour demand in real-time, allowing the city to adapt training curricula and investment policies instantly to ensure a continuous pipeline of skilled talent for new and emerging virtual economy jobs.

Table 11 Domain 9: Human Capital

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State

D9-1	Skills Inventory	Has HR mapped current and required competencies (XR, AI, data ethics, change management) across all departments?			
D9-2	Capacity-Building Plan	Is there a funded, time-bound capacity building roadmap and succession strategy to assesses staffing skills, technical knowledge, internal training, and ability to manage changes and sustain immersive or AI-based services?			
D9-3	IT/OT Convergence Expertise	Does the city have specialized expertise in converging information technology and operational technology systems for secure citiverse implementation?			
D9-4	Recruitment Strategy	Are specialized roles defined and recruitment processes established for citiverse talent?			
D9-5	Performance Management	Are job descriptions and performance criteria updated to include citiverse digital transformation competencies?			
D9-6	Knowledge Management	Are knowledge-sharing systems established to support citiverse development with best practices and expert guidance?			
D9-7	Employee Engagement	Are staff engagement and feedback mechanisms established for transformation initiatives?			
D9-8	Citiverse Human Capital Leadership	Is there a designated executive or unit (reporting to the strategic leadership) responsible for developing the *human capital strategy* – including talent acquisition, upskilling, and change management – necessary to support the citiverse transition?			
D9-9	Future of Work	Where exactly will citiverse deployment create new jobs and industries in our city – and what targeted policies can accelerate this economic growth?			

4.10 Domain 10: Financial Capital

4.10.1 Budget & Funding

D10-1 Budget Robustness

Are multi-year budgets with contingency plans allocated for citiverse initiatives, including digital/physical infrastructure and inclusive access for citizens, startups and SMEs?

a) Funding for citiverse is ad hoc, project-by-project, with no multi-year view.

b) A high-level budget estimate exists but is not formally approved and lacks contingency.

c) A detailed, multi-year budget for core infrastructure is drafted and under review by finance.
d) A multi-year budget is approved by council, including specific allocations for inclusivity programmes and a standard contingency reserve.
e) The budget is performance-linked, with flexible funding pools that can be reallocated between initiatives based on success, and includes a dedicated innovation fund for experimentation.

D10-2 Citiverse Innovation Investment
Does the citiverse initiative allocate a dedicated annual innovation budget that is (a) proportional to its strategic roadmap (e.g., ⩾X% of total funding), (b) explicitly earmarked for experimental pilots (e.g., AI-driven urban simulations, immersive citizen engagement tools), and (c) benchmarked against comparable metaverse/digital twin projects in peer cities or industries?
a) No dedicated innovation budget exists; experimental work must compete with operational funding.
b) A small, discretionary fund exists but is not proportional to the roadmap or formally earmarked.
c) A proposal for a dedicated innovation budget, benchmarked against peers, has been submitted for approval.
d) A dedicated annual innovation budget (e.g., 10–15% of total programme funding) is approved and allocated for experimental pilots.
e) The innovation budget is managed as a portfolio, with a mix of high-risk/high-reward bets and incremental improvements, and its ROI is rigorously evaluated to inform future allocations.

4.10.2 Value Measurement & ROI

D10-3 Value Realization and RoI Framework
Is there a defined framework for measuring the Return on Investment (RoI) and broader public value (e.g., social, environmental) generated by citiverse initiatives, with regular reporting against targets?
a) Value is measured anecdotally or not at all.
b) Basic financial RoI is calculated, but broader public value is not quantified.
c) A framework for measuring social, environmental, and economic value is under development.
d) A comprehensive value realization framework is in use, with regular public reporting on performance against targets.
e) The framework uses advanced techniques like social return on investment (SROI) and is integrated with budget planning, ensuring funding follows demonstrated value.

D10-4 Climate Financial Risk Integration

Are citiverse financial planning and investment decisions formally integrated with assessments of climate-related financial risks (e.g., transitional and physical risks) to ensure long-term sustainability and resilience of the financial capital?
a) Climate-related financial risks are not formally considered in citiverse budgeting or financial planning.
b) Climate risks are discussed at a high level, but no quantitative assessment or integration into financial models is performed.
c) A qualitative assessment of physical climate risks (e.g., flooding impact on physical assets) is underway to inform future budgeting.
d) Quantitative modelling of physical risks (e.g., insurance costs due to extreme weather) and

transitional risks (e.g., policy changes affecting carbon-intensive assets) is formally integrated into multi-year financial forecasts.
e) Citiverse financial strategy is benchmarked against Task Force on Climate-related Financial Disclosures (TCFD) recommendations, and all major investment decisions are stress-tested against worst-case climate scenarios to ensure the long-term solvency and resilience of the initiative.

D10-5 Financial Controls
Are financial management and audit controls established for digital transformation projects?
a) Standard city financial controls are applied to digital projects without any specific adaptation for technology risks or project scale.
b) Basic financial tracking is in place, but internal audit has not yet reviewed or customized controls for digital transformation or citiverse.
c) Project-specific financial management controls are established, including clear processes for capital expenditure approval, procurement, and budget variance reporting for all major citiverse components.
d) Independent, specialized digital project audits are conducted annually, focusing on technology procurement, vendor lock-in risk, intellectual property ownership, and the integrity of data used for performance-based contracts.
e) Financial controls are dynamically integrated with project execution platforms, providing real-time transparency on spending against technical milestones, and audit results directly inform and adjust future funding allocation models.

Table 12 Domain 10: Financial Capital

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D10-1	Budget Robustness	Are multi-year budgets with contingency plans allocated for citiverse initiatives, including digital/physical infrastructure and inclusive access for citizens, startups and SMEs?			
D10-2	Citiverse Innovation Investment	Does the citiverse initiative allocate a dedicated annual innovation budget that is (a) proportional to its strategic roadmap (e.g., ⩾X% of total funding), (b) explicitly earmarked for experimental pilots (e.g., AI-driven urban simulations, immersive citizen engagement tools), and (c) benchmarked against comparable metaverse/digital twin projects in peer cities or industries?			
D10-3	Value Realization and RoI Framework	Is there a defined framework for measuring the Return on Investment (RoI) and broader public value (e.g., social, environmental) generated by citiverse initiatives, with regular reporting against targets?			
D10-4	Climate Financial Risk Integration	Are citiverse financial planning and investment decisions formally integrated with assessments of climate-			

		related financial risks (e.g., transitional and physical risks) to ensure long-term sustainability and resilience of the financial capital?			
D10-5	Financial Controls	Are financial management and audit controls established for digital transformation projects?			

4.11 Domain 11: Adoption and Incentives

D11-1 Societal Readiness Levels

To what extent has the local community demonstrated readiness to adopt and adapt to citiverse technologies?

a) No formal assessment of community digital literacy or willingness to use the citiverse has been conducted.

b) An initial survey identified general digital access gaps, but trust and specific adoption barriers remain unaddressed.

c) Targeted digital literacy programmes are deployed in key neighbourhoods, and a baseline metric for public trust in the citiverse has been established.

d) The community exhibits a measurable level of readiness, demonstrated by widespread adoption of basic citiverse services, high participation rates in virtual consultations, and a strong public feedback loop informing design.

e) Societal readiness is a continuously managed factor, where the community actively co-develops training and outreach programmes, resulting in equitable and proactive participation across all demographic groups and a high level of self-governance in virtual spaces.

D11-2 Societal Readiness Roadmap

Has a Societal Readiness Roadmap been developed for citiverse initiatives, outlining how citizen awareness, engagement, inclusion, and trust will be built at each stage of adoption?

a) No societal readiness plan exists; the assumption is "if we build it, they will come."

b) A communications plan exists for launch, but not a comprehensive roadmap for building readiness.

c) A draft Societal Readiness Roadmap, aligned with the implementation timeline, is being developed.

d) A detailed roadmap is being executed, with targeted activities (literacy programmes, demo centres) for different citizen segments.

e) Readiness is measured quantitatively, and the roadmap is adjusted in real-time based on adoption metrics and sentiment analysis.

D11-3 Adoption Incentives and Targets

Are there specific, measurable targets for citizen and business adoption of core citiverse services, supported by incentive programmes (e.g., tax credits for SMEs, digital literacy campaigns) to achieve them?

a) There are no adoption targets or incentives.

b) Internal usage targets exist, but not for broader citizen or business adoption.

c) Adoption targets have been set, and a package of potential incentives is being designed.

d) Public adoption targets are published, and active incentive programmes (e.g., free access, training, grants) are available.
e) Incentives are highly targeted and data-driven, successfully achieving and exceeding adoption goals across all demographic groups.

D11-4: Participatory Budgeting Integration
Is the citiverse platform actively used as a core mechanism for implementing Participatory Budgeting, allowing citizens to propose, discuss, and vote on the allocation of public funds?
a) Participatory budgeting is not practiced, or it exists entirely outside of any citiverse or digital platform.
b) The citiverse is used only for announcing PB initiatives, but the actual voting/discussion happens offline or on a separate basic web page.
c) The citiverse is piloting its first Participatory budgeting module, allowing citizens to submit ideas and vote within the virtual environment.
d) The citiverse platform is the primary tool for Participatory budgeting, integrating real-time discussion, proposal visualization (e.g., in a digital twin), and verifiable voting for specific public projects.
e) Participatory budgeting within the citiverse is a transparent, continuous, and institutionalized process, with funds regularly allocated and the outcomes of citizen-voted projects actively displayed in the virtual world.

D11-5: Co-Design Methodologies
Are formal co-design methodologies (e.g., design sprints, human-centred design workshops) mandated and implemented with diverse citizen groups for the development of all major citiverse services and virtual spaces?
a) Citiverse services are designed internally by city staff and vendors with no citizen input until launch.
b) The city holds public consultation meetings to gather generalized feedback on completed designs.
c) Co-design sessions are occasionally conducted with a small, self-selected group of early adopters for specific pilot projects.
d) A formal co-design mandate requires all major citiverse projects to use documented methodologies (e.g., iterative prototyping) involving diverse, targeted groups of citizens, including those digitally marginalized.
e) The city runs a permanent, funded Citizen Co-Design Lab leveraging the citiverse for rapid prototyping, and citizens are compensated for their expert input into service design.

D11-6: Digital Democracy Tools
Does the citiverse integrate advanced digital democracy tools that go beyond simple polling, enabling structured online deliberation, policy co-creation, and traceable feedback loops into the policy-making process?
a) The citiverse does not offer any tools for policy participation beyond links to external government websites.
b) The platform offers basic features like simple polls and suggestion boxes for minor issues.
c) The citiverse integrates intermediate tools allowing citizens to comment on draft policies and participate in live, moderated virtual town halls.

d) Advanced digital democracy tools are implemented, enabling structured online deliberation, policy tagging, transparent tracking of policy amendments, and official policy feedback loops.
e) The citiverse acts as a true deliberative space, featuring AI-supported mechanisms to summarize diverse viewpoints, identify consensus, and directly integrate citizen co-created legislative text into the formal policy review process.

D11-7: Meaningful Citizen Engagement Metrics
Are there established and regularly tracked metrics for meaningful citizen engagement within the citiverse, focusing on the quality, diversity, and impact of citizen input rather than just raw participation numbers?
a) Engagement is only measured by simple counts, such as the number of website visits or total virtual users.
b) Metrics include basic interaction data (e.g., time spent on a page, number of comments) but not impact.
c) The city tracks the diversity of participants (e.g., by age, neighbourhood) and begins to categorize the type of input (e.g., idea, critique, support).
d) The city has formally adopted a set of Meaningful Engagement Metrics that track diversity, the quality/substance of input, and the percentage of citizen suggestions that lead to a tangible, traceable policy or service change.
e) MEMs are integrated into performance reporting for city leadership, and the citiverse team's performance bonuses are tied to demonstrable increases in the impact and representativeness of citizen input.

D11-8: Organizational Change Readiness Plan
Have gap-closure strategies and implementation plans been developed based on the Organizational Change Readiness Assessment?
a) A readiness assessment was completed, but no formal gap-closure strategies or implementation plans have been developed.
b) A high-level list of required actions exists, but it lacks specific budgets, timelines, or assigned ownership.
c) Formal gap-closure plans are developed and approved for critical areas (e.g., specific training, updated policies) and are partially integrated into the citiverse project schedule.
d) Comprehensive, multi-year Organizational Change Management (OCM) plans are fully integrated, resourced, and actively deployed, including specific metrics to track the successful adoption of new roles, processes, and tools across affected departments.
e) The OCM plan is a living document that uses real-time feedback and usage data from the citiverse to dynamically adjust training, communication, and support strategies, ensuring continuous organizational alignment and cultural shift.

Table 13 Domain 11: Adoption and Incentives

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D11-1	Societal Readiness Levels	To what extent has the local community demonstrated readiness to adopt and adapt to citiverse technologies?			

D11-2	Societal Readiness Roadmap	Has a Societal Readiness Roadmap been developed for citiverse initiatives, outlining how citizen awareness, engagement, inclusion, and trust will be built at each stage of adoption?			
D11-3	Adoption Incentives and Targets	Are there specific, measurable targets for citizen and business adoption of core citiverse services, supported by incentive programmes (e.g., tax credits for SMEs, digital literacy campaigns) to achieve them?			
D11-4	Participatory Budgeting Integration	Is the citiverse platform actively used as a core mechanism for implementing Participatory Budgeting, allowing citizens to propose, discuss, and vote on the allocation of public funds?			
D11-5	Co-Design Methodologies	Are formal co-design methodologies (e.g., design sprints, human-centred design workshops) mandated and implemented with diverse citizen groups for the development of all major citiverse services and virtual spaces?			
D11-6	Digital Democracy Tools	Does the citiverse integrate advanced digital democracy tools that go beyond simple polling, enabling structured online deliberation, policy co-creation, and traceable feedback loops into the policy-making process?			
D11-7	Meaningful Citizen Engagement Metrics	Are there established and regularly tracked metrics for meaningful citizen engagement within the citiverse, focusing on the quality, diversity, and impact of citizen input rather than just raw participation numbers?			
D11-8	Organizational Change Readiness Plan	Have gap-closure strategies and implementation plans been developed based on the Organizational Change Readiness Assessment?			

4.12 Domain 12: Ecosystem and Stakeholders

4.12.1 Stakeholder Engagement

D12-1 Stakeholder Mapping

Are all key stakeholders identified, and engagement strategies developed?

a) Stakeholders are engaged reactively when issues arise.

b) A basic list of stakeholders exists, but no tailored engagement strategies.

c) A comprehensive stakeholder map is being developed, with analysis of influence and interest.

d) A dynamic stakeholder map is maintained, with customized engagement plans for each key group.

e) Engagement is predictive; the system identifies emerging stakeholder groups or shifting sentiments based on public data, allowing for proactive outreach.

D12-2 Feedback Mechanisms
Are systematic feedback collection and response systems in place?
a) Feedback is collected passively (e.g., a generic contact form) with no systematic response.
b) Feedback is collected but not consistently analysed or acted upon.
c) Dedicated feedback channels for citiverse (e.g., portals, in-world tools) are being implemented.
d) An integrated system collects, analyses, and routes feedback, with service level agreements for responses.
e) Feedback is closed-loop; citizens are notified of how their input influenced decisions, building trust and encouraging participation.

D12-3 Civic Participation Platform
Are digital platforms established for citizen engagement in citiverse planning?
a) No digital platforms are used for citiverse engagement.
b) Existing social media or council meeting channels are used for announcements.
c) A pilot platform for online consultations on citiverse topics is being tested.
d) A dedicated, accessible digital platform enables two-way dialogue, ideation, and co-design on citiverse plans.
e) The platform is integrated with the citiverse itself, allowing citizens to experience and comment on virtual prototypes in real-time.

D12-4 Community Outreach
Are comprehensive community engagement programmes implemented?
a) Outreach is limited to press releases and public meetings.
b) Some targeted workshops have been held, but not as part of a comprehensive programme.
c) A structured community outreach programme for the citiverse, targeting diverse neighbourhoods, is being rolled out.
d) A multichannel outreach programme (digital, in-person, immersive) is actively used to build awareness and gather input.
e) Outreach is led by community ambassadors, and its effectiveness is measured by the diversity and depth of participation.

D12-5 Youth Participation
Is our citiverse strategy effectively activating children and younger generations as co-designers of their urban future – through accessible digital platforms, meaningful decision-making roles, and tools that translate their ideas into actionable policies?
a) Youth are considered passive beneficiaries, not active participants.
b) School visits or competitions are held, but without a clear path to influence policy.
c) A youth advisory council for the citiverse has been established and is providing input.
d) Digital tools designed for youth (e.g., in-world building tools, gamified surveys) are used to gather and incorporate their ideas.
e) Youth-led projects within the citiverse receive funding and mentorship, and their outcomes directly inform city planning decisions.

D12-6 Aging Society

Is our citiverse strategy comprehensively addressing the needs of aging populations through accessible technology, health innovation, social inclusion, economic participation, and caregiver support – while respecting diverse ability levels and life experiences?
a) The needs of aging populations are an afterthought in citiverse design.
b) Basic accessibility is considered, but not holistic social, health, and economic inclusion.
c) A dedicated task force is exploring how the citiverse can support aging-in-place and social connection.
d) Specific services and interfaces for older adults are available, focusing on health monitoring, virtual community centres, and simplified access.
e) The citiverse is a key tool in the city's aging strategy, reducing isolation, extending employability, and providing integrated support for caregivers.

D12-7 Gender Equality and Family Friendly
Is our city leveraging the citiverse—through digital tools, data-driven policies, and inclusive urban design – to create public spaces and services that actively promote gender equality and support families of all structures?
a) Gender and family perspectives are not incorporated into citiverse planning.
b) The principle of non-discrimination is stated, but not actively designed for.
c) Gender-impact assessments are being introduced for new citiverse projects.
d) The citiverse includes features designed with and for women and families, such as safe virtual spaces and services that reduce unpaid care burdens.
e) The city uses data from the citiverse to identify and rectify gender inequalities in the use of physical and digital public spaces.

D12-8 Stakeholder Risk Communication
Are risk communication channels established with citizens, businesses, academic institutes, NGOs, and partner organizations?
a) Risks are not proactively communicated to stakeholders.
b) Communication happens only during a crisis.
c) A draft stakeholder risk communication plan has been developed.
d) Proactive, transparent communication about potential risks and mitigation measures is standard practice.
e) The city uses targeted campaigns and simulations to build stakeholder resilience and understanding of citiverse-related risks.

4.12.2 Partnerships & Collaboration

D12-9 Private Sector Collaboration
Are strategic partnerships developed with technology companies and service providers?
a) The city interacts with the private sector only through procurement.
b) Ad hoc meetings occur, but no strategic partnership programme exists.
c) A strategy for engaging tech companies as innovation partners is being developed.
d) Long-term strategic partnerships are in place with key technology providers, focusing on co-development.
e) The city operates a curated innovation ecosystem where startups and corporations collaborate with the city on solving urban challenges via the citiverse platform.

D12-10 Academic Partnerships

Are research collaborations established with universities and research institutions?
a) There is no formal collaboration with academic institutions.
b) Individual staff may have academic connections, but not as part of a city strategy.
c) Framework agreements with key universities are being negotiated to facilitate research collaboration.
d) Joint research centres or living labs are established, using the city as a testbed for citiverse research.
e) Research outcomes are directly fed into policy and implementation, and the city funds dedicated PhD programmes on urban citiverse topics.

Table 14 Domain 12: Ecosystem and Stakeholders

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D12-1	Stakeholder Mapping	Are all key stakeholders identified, and engagement strategies developed?			
D12-2	Feedback Mechanisms	Are systematic feedback collection and response systems in place?			
D12-3	Civic Participation Platform	Are digital platforms established for citizen engagement in citiverse planning?			
D12-4	Community Outreach	Are comprehensive community engagement programmes implemented?			
D12-5	Youth Participation	Is our citiverse strategy effectively activating children and younger generations as co-designers of their urban future – through accessible digital platforms, meaningful decision-making roles, and tools that translate their ideas into actionable policies?			
D12-6	Aging Society	Is our citiverse strategy comprehensively addressing the needs of aging populations through accessible technology, health innovation, social inclusion, economic participation, and caregiver support – while respecting diverse ability levels and life experiences?			
D12-7	Gender Equality and Family Friendly	Is our city leveraging the citiverse – through digital tools, data-driven policies, and inclusive urban design – to create public spaces and services that actively promote gender equality and support families of all structures?			
D12-8	Stakeholder Risk Communication	Are risk communication channels established with citizens, businesses, academic institutes, NGOs, and partner organizations?			
D12-9	Private Sector Collaboration	Are strategic partnerships developed with technology companies and			

		service providers?			
D12-10	Academic Partnerships	Are research collaborations established with universities and research institutions?			

4.13 Domain 13: Trust and Safety

4.13.1 Trust & Safety Operations

D13-1 Digital Forensics and Evidence Preservation
Are there established protocols and tools for digital forensics and evidence preservation in the citiverse, in coordination with law enforcement, to address criminal activities?
a) No protocols or tools exist for citiverse forensics.
b) Standard IT forensics tools are used, but they are not adapted for immersive environments.
c) Protocols are being drafted in consultation with the police department.
d) Specialized tools and trained personnel are available, and memoranda of understanding with law enforcement are in place.
e) The city's digital forensics capability is accredited and can serve as a resource for other municipalities.

D13-2 Blockchain-Based Trust Mechanisms
Are blockchain technologies implemented for decentralized identity management, smart contracts for user consent, and immutable audit trails to enhance trust and security?
a) Blockchain is not used or being considered.
b) Its potential is being researched, but no implementation plans exist.
c) Pilot projects are testing blockchain for specific use cases like digital asset ownership.
d) Blockchain is integrated into core services for secure, verifiable transactions and consent management.
e) The city's use of blockchain for public service delivery is transparent, efficient, and has significantly increased citizen trust in digital transactions.

D13-3 Trust and Safety Operations
Are comprehensive trust and safety operations established covering prevention, detection, enforcement, redress, and resilience with clear escalation paths for different severity levels?
a) Trust and safety are managed reactively by general IT support.
b) A basic Code of Conduct exists, but there is no dedicated operations team.
c) A trust and safety team is being hired, and operational procedures are being written.
d) A 24/7 trust and safety operations centre is active, with clear protocols for incident response and user support.
e) Operations are proactive, using AI to detect emerging harm patterns, and include restorative justice programmes for low-level offences.

D13-4 Content Moderation Framework
Are AI-assisted content moderation tools with human oversight implemented to detect and address harmful behaviour, misinformation, and safety violations?
a) Content moderation is purely reactive, based on user reports.
b) Basic keyword filtering is used, but no AI or dedicated human moderators.

c) AI moderation tools are being piloted, and a human moderation team is being trained.
d) A multilayered moderation system combines AI pre-screening with human review for context.
e) The moderation framework is transparent about its rules and performance, and it continuously learns from reviewer feedback to improve accuracy.

D13-5 Digital Addiction Prevention
Are explicit design guidelines and features implemented within the citiverse to promote healthy use, prevent digital addiction, and encourage transitions back to real-world engagement?
a) No policies or design features exist to address digital addiction.
b) The topic is acknowledged, and basic informational warnings are provided.
c) Design guidelines encourage breaks, and opt-in tools for limiting session length are being piloted.
d) Built-in features actively prompt users to take breaks, encourage physical movement, and promote real-world city activities based on their virtual usage patterns.
e) The city partners with public health organizations to offer educational programmes and clinical resources directly linked to virtual usage data (with consent).

D13-6 Ethical Virtual Companions
Are virtual companions and digital avatars designed with transparency and programmed to enhance – rather than replace – authentic human relationships?
a) Virtual companions are unregulated and designed primarily for maximizing engagement time.
b) A policy states that companions must disclose their non-human status, but design remains opaque.
c) Companions are designed with clear ethical boundaries, and the underlying AI models are audited for psychological manipulation.
d) Companions are explicitly programmed with "relationship-enhancing" goals, such as prompting real-world meetups or encouraging communication with human friends.
e) Companion design is co-created with psychological experts and audited for transparency, focusing on aiding civic participation rather than fostering dependency.

D13-7 Screen Time Management
Are tools and policies provided to users for managing and capping their screen time within the citiverse, and are these limits actively promoted to mitigate overuse?
a) The city does not track or provide tools for managing user screen time.
b) Users can manually check their usage history, but there are no limit-setting features.
c) Users can set daily or weekly screen time limits via a preference panel, but enforcement is soft.
d) Mandatory, easily accessible tools allow users to set and automatically enforce personalized screen time caps, with notifications promoting logging off.
e) Screen time data is used (anonymously) to inform public service design, ensuring vital information is accessible even to users with strict self-imposed limits.

D13-8 Social Isolation and VR/AR Risk Mitigation
Are proactive measures and specific design features implemented to mitigate the risks of social isolation and psychological harm deriving from prolonged or intense immersion in VR/AR environments?
a) No mitigation strategies are in place for social isolation or psychological risks related to

immersion.
b) General well-being guidelines are posted, but they are not specific to immersive technology.
c) Mandatory tutorials on safe VR/AR use and how to distinguish between virtual and real-world interactions are integrated into onboarding.
d) Specific design features (e.g., forced breaks, reality checks, clear spatial boundaries) are integrated to reduce disorientation and social displacement.
e) The city actively monitors research on immersion risks and adjusts the citiverse design in real-time, offering in-world peer support groups and easy access to mental health resources.

Table 15 Domain 13: Trust and Safety

Indicator ID	Indicator name	Assessment prompt	Documented Evidence	Current State	Target State
D13-1	Digital Forensics and Evidence Preservation	Are there established protocols and tools for digital forensics and evidence preservation in the citiverse, in coordination with law enforcement, to address criminal activities?			
D13-2	Blockchain-Based Trust Mechanisms	Are blockchain technologies implemented for decentralized identity management, smart contracts for user consent, and immutable audit trails to enhance trust and security?			
D13-3	Trust and Safety Operations	Are comprehensive trust and safety operations established covering prevention, detection, enforcement, redress, and resilience with clear escalation paths for different severity levels?			
D13-4	Content Moderation Framework	Are AI-assisted content moderation tools with human oversight implemented to detect and address harmful behaviour, misinformation, and safety violations?			
D13-5	Digital Addiction Prevention	Are explicit design guidelines and features implemented within the citiverse to promote healthy use, prevent digital addiction, and encourage transitions back to real-world engagement?			
D13-6	Ethical Virtual Companions	Are virtual companions and digital avatars designed with transparency and programmed to enhance – rather than replace – authentic human relationships?			
D13-7	Screen Time Management	Are tools and policies provided to users for managing and capping their screen time within the citiverse, and are these limits actively promoted to mitigate			

		overuse?			
D13-8	Social Isolation and VR/AR Risk Mitigation	Are proactive measures and specific design features implemented to mitigate the risks of social isolation and psychological harm deriving from prolonged or intense immersion in VR/AR environments?			

4.14 Domain 14: Success and Impact

4.14.1 Performance Monitoring

D14-1 Performance Monitoring
Are system performance and user experience continuously monitored?
a) System performance is checked only when users report problems.
b) Basic uptime and latency are monitored for core infrastructure.
c) A comprehensive monitoring plan for technical performance and user experience is being implemented.
d) Real-time dashboards track system health and user engagement metrics, with alerts for anomalies.
e) Monitoring is predictive, identifying potential performance degradation before it impacts users, and automatically triggering scaling or repair processes.

D14-2 Continuous Improvement
Are feedback loops established for ongoing system optimization?
a) Systems are deployed and only updated for major bugs or upgrades.
b) User feedback is collected but not systematically used for optimization.
c) Processes are being set up to regularly review feedback and performance data for improvements.
d) Agile development cycles incorporate user feedback into regular, iterative releases.
e) The entire citiverse platform is designed as a learning system, with A/B testing and data-driven decisioning used to autonomously optimize user flows and service delivery.

D14-3 Benchmark Analysis
Are performance benchmarks established against other citiverse initiatives?
a) No benchmarking is conducted.
b) Informal comparisons are made based on public information.
c) A formal benchmarking study against leading cities is planned or underway.
d) Key performance indicators are regularly benchmarked against a peer group of cities.
e) Benchmarking results are used to set aggressive performance targets and drive innovation, making the city a top performer globally.

4.14.2 Impact Assessment

D14-4 Impact Assessment
Are social, economic, and environmental impacts of the citiverse initiative regularly assessed?
a) Impact is not formally assessed beyond basic project delivery.

b) Post-project reviews are conducted, but they focus on schedule and budget, not broader impact.
c) A framework for conducting social, economic, and environmental impact assessments is being adopted.
d) Standardized impact assessments are conducted for all major initiatives before, during and after implementation.
e) Impact data is used to dynamically re-prioritize the project portfolio, doubling down on what works and stopping what does not.

D14-5 Mental Health and Wellbeing
Does regular engagement with the citiverse influence the mental health and overall wellbeing of its participants?
a) No data are collected on mental health or wellbeing impacts.
b) Anecdotal concerns exist, but no structured research or monitoring is in place.
c) A partnership with public health agencies is being formed to study potential impacts.
d) Wellbeing metrics are tracked as part of user experience monitoring, and design guidelines to promote digital wellness are enforced.
e) The citiverse is explicitly designed to be a net positive for mental health, with features that reduce loneliness, promote mindfulness, and are proven to improve wellbeing.

D14-6 Equitable Access to the Benefits of Citiverse
Can your citizens benefit equitably from the value-added services or products as a result of the deployment of the citiverse ecosystem?
a) Access to benefits is unequal, reinforcing existing digital and social divides.
b) The goal of equity is stated, but no specific measures are in place to achieve it.
c) Equity impact assessments are being integrated into project planning to identify and mitigate barriers.
d) Proactive programmes (device lending, subsidized connectivity, digital literacy) ensure all demographic groups can access and benefit from core services.
e) Equitable outcomes are a primary KPI; the city can demonstrate that the citiverse has reduced, not increased, key inequalities in access to services, economic opportunity, and civic participation.

D14-7 Disability-Disaggregated Data
Is progress towards an inclusive and equitable citiverse measured using disability-disaggregated data, in line with CRPD Article 31 and Sustainable Development Goal 17, to ensure that "no one is left behind" and to identify and address barriers faced by persons with disabilities?
a) Data on usage and impact is not disaggregated by disability status.
b) Disability is included in general diversity monitoring, but not for specific citiverse service impact.
c) A plan to start collecting and analysing disability-disaggregated data for key services is being developed.
d) Disability-disaggregated data are routinely collected, reported, and used to make service improvements.
e) The city's reporting on citiverse inclusion is a model for CRPD compliance, and the data reveals and drives continuous improvement in accessibility and participation for persons with disabilities.

Table 16 Domain 14: Success and Impact

Indicator ID	Indicator name	Assessment prompt	Documented evidence	Current State	Target State
D14-1	Performance Monitoring	Are system performance and user experience continuously monitored?			
D14-2	Continuous Improvement	Are feedback loops established for ongoing system optimization?			
D14-3	Benchmark Analysis	Are performance benchmarks established against other citiverse initiatives?			
D14-4	Impact Assessment	Are social, economic and environmental impacts regularly assessed?			
D14-5	Mental Health and Wellbeing	Does regular engagement with the citiverse influence the mental health and overall wellbeing of its participants?			
D14-6	Equitable Access to the Benefits of Citiverse	Can your citizens benefit equitably from the value-added services or products as a result of the deployment of the citiverse ecosystem?			
D14-7	Disability-Disaggregated Data	Is progress towards an inclusive and equitable citiverse measured using disability-disaggregated data, in line with CRPD Article 31 and Sustainable Development Goal 17, to ensure "no one is left behind" and to identify and address barriers faced by persons with disabilities?			

5 Summary dashboard

The summary dashboard (as shown in Table 17) consolidates the results of the checklist into a single view. It highlights current and target averages, identifies performance gaps, and assigns priorities, allowing city leaders to focus resources on the most critical areas.

Table 17 Summary Dashboard

Domain	Domain name	Gap	Priority	Weighting	Interdependency Mapping	Funding Source
D1	**Vision and Strategy**					
D2	**Barriers to Implementation**					
D3	**Use Case Pipeline**					
D4	**Governance and Regulations**					
D5	**Technology Infrastructure**					
D6	**Data Privacy and Protection**					
D7	**Security and Resilience**					
D8	**Inclusivity and Accessibility**					
D9	**Human Capital**					
D10	**Financial Capital**					
D11	**Adoption and Incentives**					
D12	**Ecosystem and Stakeholder**					
D13	**Trust and Safety**					
D14	**Success and Impact**					

6 Action plan

The action plan (as shown in Table 18) translates assessment results into practical steps. It assigns responsibility, establishes timelines and budgets, and tracks implementation progress. This ensures that identified priorities are addressed systematically and transparently.

Action plan instructions:

1) Include high-priority items from the Checklist
2) Assign responsible leaders and realistic timelines
3) Estimate budget requirements
4) Track progress regularly
5) Update status as actions are completed

Table 18 Action plan

Priority	Indicator	Action required	Responsible leaders	Timeline	Budget	Number of projects	Number of departments involved	Number of citizens involved	Citizens satisfaction rate	Status

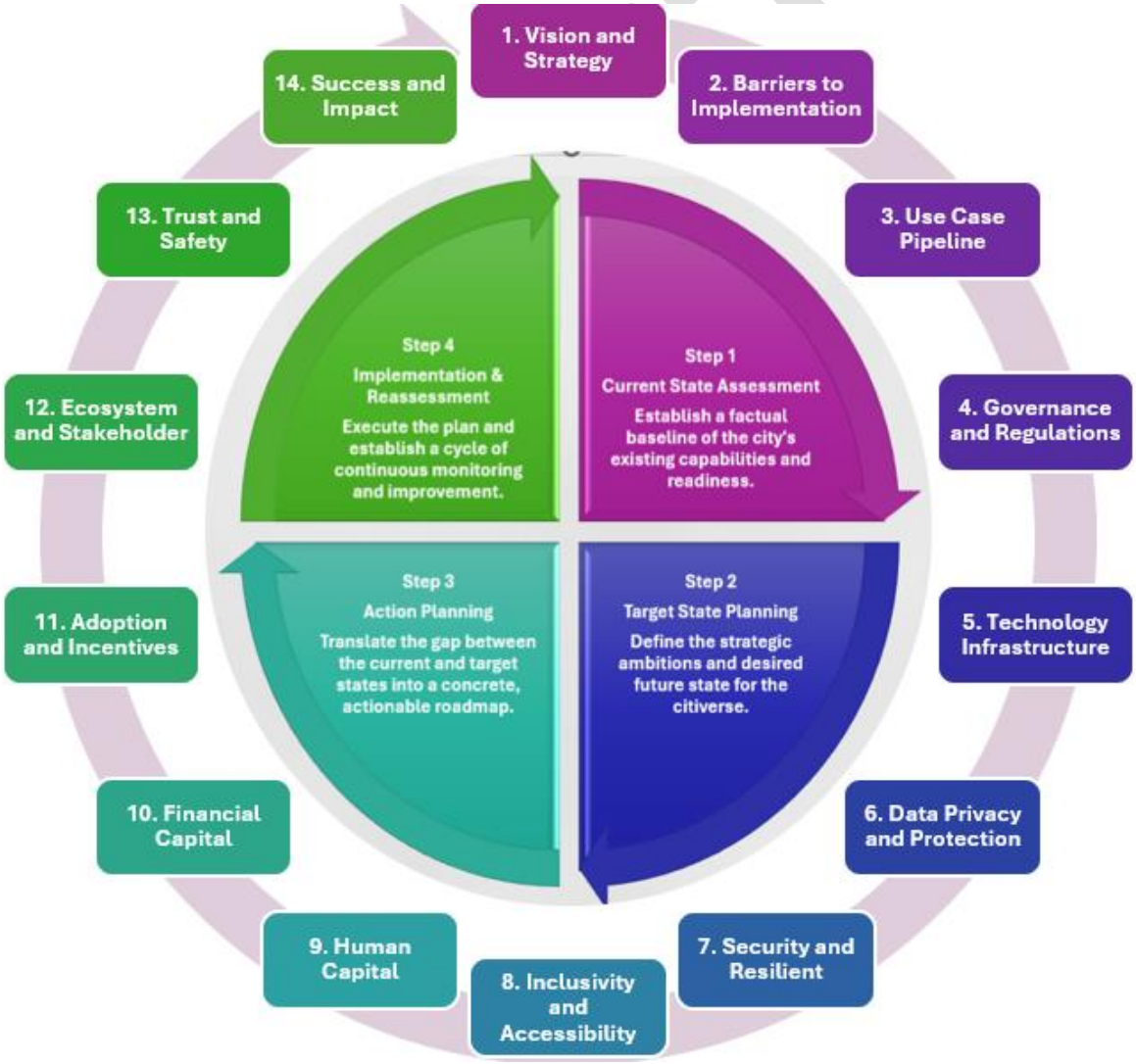
7 Methodology

This section outlines a practical, iterative methodology for cities to apply the Citiverse Ex-ante Evaluation Framework. This process transforms the static assessment into a dynamic strategic planning tool, guiding cities from their current state to their desired future.

Overview of the Four-Step Implementation Process

The process is designed to be cyclical, allowing cities to reassess and adapt their strategies over time as they progress and as technologies evolve.

Figure 1: Implementation Cycle



Step 1: Current State Assessment (Baselining)

Core Objective: Establish a factual baseline of the city's existing capabilities and readiness.

Key Activities:

- Systematically evaluate the status for each framework sub-component by selecting the most accurate descriptive option.
- Document evidence and justifications for all selections to ensure objectivity.
- Generate a snapshot of strengths and gaps to serve as the foundational reference point for all subsequent planning.

Outcome: This baseline is not a judgment but a factual starting point from which to build.

Step 2: Target State Planning

Core Objective: Define the strategic ambitions and desired future state for the citiverse.

Key Activities:

- Prioritize components for development based on local needs, resources, and policy objectives.
- Set clear, achievable targets by determining the desired future state for each prioritized sub-component.
- Create a vision for the citiverse journey that aligns with broader city goals, such as sustainability, economic development, or social equity.

Outcome: A clear and prioritized strategic vision that directs all subsequent actions.

Step 3: Action Planning

Core Objective: Translate the gap between the current and target states into a concrete, actionable roadmap.

Key Activities:

- Identify specific initiatives, projects, and policy changes required to close the identified gaps.
- Assign responsibilities, timelines, and resources for each action.
- Integrate these actions into existing city budgeting, procurement, and departmental work plans to ensure feasibility and ownership.

Outcome: A detailed execution plan that is fully resourced and integrated into municipal operations.

Step 4: Implementation & Reassessment

Core Objective: Execute the plan and establish a cycle of continuous monitoring and improvement.

Key Activities:

- Execute the action plan, monitoring progress against the defined timelines and milestones.
- Reassess the baseline after an implementation period (e.g., 12–18 months) to measure progress and recalibrate targets.
- Foster a culture of continuous learning and adaptation to keep the citiverse strategy relevant and effective.

Outcome: Tangible progress and an evolving strategy that adapts to new challenges and opportunities.

This structured yet flexible methodology ensures that the framework is not just an assessment tool but a powerful engine for tangible urban transformation.

8 Conclusions

Preparing for the citiverse – A Practical Implementation Checklist provides city leaders with a structured approach to assess readiness, set priorities, and plan actions for inclusive and sustainable digital transformation. By addressing governance, infrastructure, innovation and long-term resilience, the checklist offers a comprehensive yet adaptable tool that can be applied by cities of all sizes and capacities.

As the citiverse evolves, this checklist should be treated as a living instrument. Cities are encouraged to revisit the checklist regularly, update their assessments, and refine their action plans in line with local priorities and emerging global best practices. Through collaboration, knowledge-sharing, and a commitment to ethical and people-centred innovation, cities can collectively shape a citiverse that delivers meaningful benefits for all.

About the Global Initiative on Virtual Worlds and AI – *Discovering the Citiverse*

Launched by ITU, UNICC, and Digital Dubai, the Global Initiative on Virtual Worlds and AI – *Discovering the Citiverse* is a multistakeholder platform dedicated to shaping the next generation of AI-powered virtual worlds[9].

These immersive digital environments are transforming how people live, learn, govern, and interact. The Initiative ensures that AI-powered virtual worlds evolve in ways that are inclusive, interoperable, and human-centric—and that they help deliver on the Pact for the Future and its Global Digital Compact.

Serving as a neutral and action-oriented platform, the Initiative brings together cities, governments, UN agencies, private sector companies, academia, and civil society to collaboratively shape the responsible development and deployment of these technologies.

The Initiative advances its mission through three strategic pillars, each supported by dedicated tracks that address the most urgent challenges and promising opportunities in AI-powered virtual worlds. This comprehensive structure enables the Initiative to deliver both high-level global guidance and practical implementation in cities worldwide.

The Initiative is supported by over 70 international partners.

For more information, please visit: https://www.itu.int/metaverse/virtual-worlds/.

Meet the Champions

Champions are entities that demonstrate leadership by providing financial contributions in support of the Initiative. This may include funding for events, challenges, research outputs, communication activities, trainings, travel grants, or other related efforts.

Ministry of Internal Affairs and Communications

دبـــي الرقمية
DIGITAL DUBAI

Meet the Founding Partners

Founding Partners are the organizations that launched the Initiative. They serve as the core convening entities and contribute to shaping its long-term vision. The Founding Partners are:

ITU

UNICC

دبـــي الرقمية
DIGITAL DUBAI

Meet the Supporters

Supporters are organizations that have expressed endorsement of the Initiative and actively participate in its activities. This includes, but is not limited to, participation in tracks, contribution of use cases, co-organization of events, provision of expertise, or public advocacy of the Initiative.

MINISTRY OF INFORMATION, COMMUNICATIONS AND THE DIGITAL ECONOMY
REPUBLIC OF KENYA

ETRI

Stanford University

IDC

Gemeente Rotterdam

UNJSPF
United Nations Joint Staff Pension Fund

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Universitat Autònoma de Barcelona

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1897

libelium

GLOBAL CITIES HUB
GENEVA

Reference

SECTION: Back_Cover_Generated-All-sector-No-ISBN
Conditions: PDF only

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[9] https://www.itu.int/metaverse/virtual-worlds/