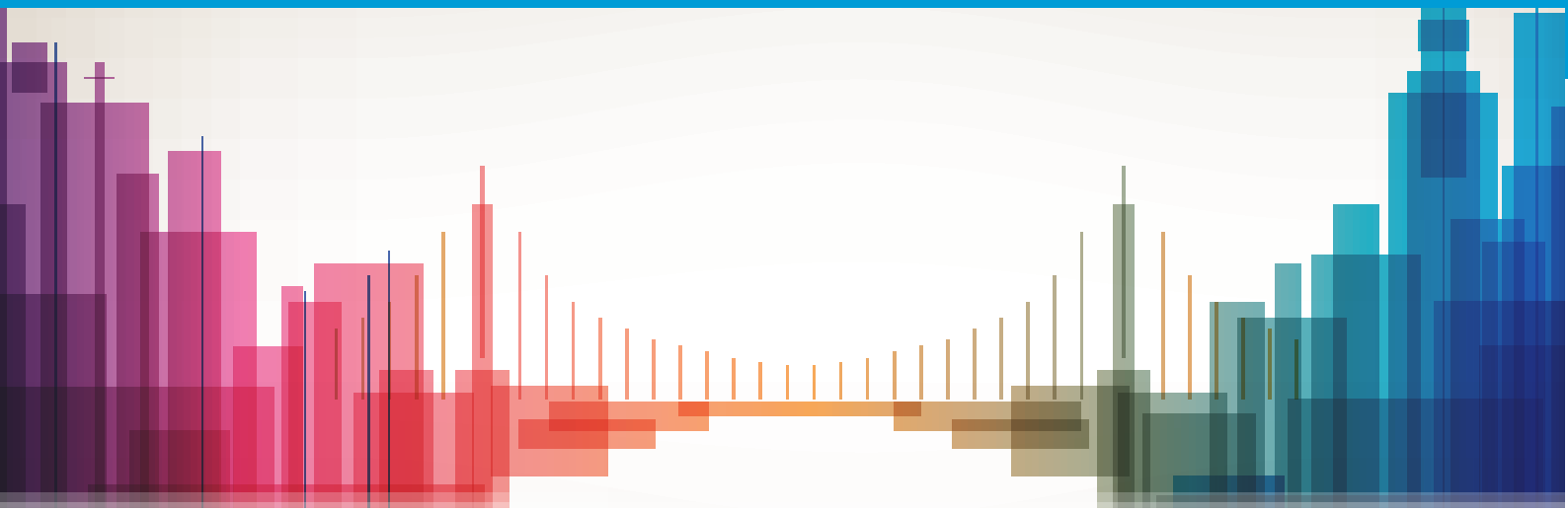
Digital Transformation Assessment of People-Centred Cities Performance and Impact Assessment Guide





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Foreword

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Disclaimer

The opinions expressed in this publication are those of the authors and do not necessarily represent the views of their respective organizations or U4SSC members. In line with the U4SSC principles, this report does not promote the adoption and use of Smart City technology. It advocates for policies encouraging responsible use of information and communications technologies (ICTs) that contribute to the economic, environmental and social sustainability as well as the advancement of the 2030 Agenda for Sustainable Development and the Pact for the Future and its Global Digital Compact.

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Abbreviations and acronyms

Abbreviation	Full form
AI	Artificial Intelligence
BAS	Building Automation Systems
CAIDI	Customer Average Interruption Duration Index
EHR	Electronic Health Record
GHG	Greenhouse Gas
GIS	Geographic Information System
HVAC	Heating, Ventilation, and Air Conditioning
ICT	Information and Communication Technologies
IoT	Internet of Things
KPI	Key Performance Indicator
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SDG	Sustainable Development Goal
U4SSC	United for Smart Sustainable Cities
UNECE	The United Nations Economic Commission for Europe
UNESCO	The United Nations Educational, Scientific and Cultural Organization
WCAG	Web Content Accessibility Guidelines
WHO	World Health Organization
ZBI	Zarit Burden Interview

Executive Summary

The Performance and Impact Assessment of Digital Transformation for People-Centred Cities Guide provides a comprehensive and flexible framework to help cities understand, plan, implement, assess and strengthen digital transformation. The Guide recognizes that digital transformation is not an end in itself. Its value lies in how effectively it contributes to inclusive economic growth, environmental sustainability, resilience, accessibility, and high-quality public service delivery, and ensure that the benefits of technological progress are equitable, inclusive, and accessible to all. It therefore places people, communities and sustainable urban development at the centre of assessment. The Performance and Impact Assessment Guide also serves as an advisory tool, encouraging cities to assess relevant measures where available, identify areas for improvement, and build progressively upon existing capacities, practices, and achievements.

Who is the Guide for?

The Guide is intended for a broad range of stakeholders involved in people-centred digital transformation, including:

- Mayors and other city government leaders
- City digital transformation agencies
- Smart city, innovation, and digital transformation teams
- Urban planners and sustainable development practitioners
- Policymakers and officials responsible for strategies, policies, and regulatory measures
- Public service providers and other institutional stakeholders
- National and subnational authorities supporting urban digital transformation
- Other partners involved in planning, implementing, financing, monitoring, or evaluating digital transformation

What can the Guide help cities achieve?

The Guide aims to support cities in:

Understanding digital maturity as multidimensional and non-linear, recognizing that cities may demonstrate different levels of maturity across urban dimensions and areas.

Assessing digital maturity from multiple perspectives, including foundational capabilities, the deployment and use of digital solutions, and the improvements and broader value generated through digital transformation.

Recognizing different pathways to digital maturity, understanding that not every KPI must encompass all three stages.

Selecting KPIs according to their priorities, context, and level of digital maturity, allowing cities to focus on the indicators most relevant to their needs and objectives.

Leveraging available data and information, recognizing that a wide range of publicly available sources can support KPI measurement process and reduce the need for cities to collect all data independently. Interpreting KPI results according to their purpose and measurement scope, without treating the absence of one or more stages as a deficiency or as indicating a lower level of digital maturity. Cities may advance differently across urban dimensions and that digital maturity does not follow a fixed sequence. Cities at earlier stages of digital transformation can use a simplified approach, while those with stronger data capabilities can undertake more detailed assessments.

The Guide presents two complementary components:

1. A **three-stage Key Performance Indicator (KPI) Framework**, which measures the performance and readiness of digital transformation across multiple dimensions.
2. A **High-Level Performance and Impact Assessment Methodology**, which evaluates the broader outcomes and longer-term impacts of digital transformation on people, communities, and sustainable urban development.

The Guide provides cities with a practical and adaptable approach to assessing and advancing digital transformation in support of sustainable urban development and the achievement of the Sustainable Development Goals (SDGs). Grounded in the principles of the Pact for the Future and the Global Digital Compact, it complements existing international guidance by promoting a coherent, flexible, and people-centred methodology. The Guide aims to support cities in ensuring that digital transformation delivers measurable, equitable, and lasting benefits for all city residents. The Guide recognizes that cities differ in their governance structures, socio-economic conditions, institutional capacities, strategic priorities and levels of digital maturity, and introduces the Performance and Impact Assessment Framework, together with guidance on its flexible and modular application. It distinguishes between Core and Advanced Key Performance Indicators (KPIs) and provides a KPI template and a Key Performance Indicator table. The Guide also provides a four-step impact assessment process comprising scoping; identifying impact aspects; conducting assessment and data collection; and evaluating impacts and mitigation. It concludes with key findings and references, and includes practical appendices containing:

- detailed information on all KPIs;
- a blank KPI template; and
- an optional data collection template.



1 Why cities should use performance and impact assessment guide

Practical Application

- **Flexible application:** The KPIs and the assessment methodology can be applied across different urban contexts and adapted to local priorities, institutional capacities and data availability. The Guide is intended as a flexible framework and a practical decision-support tool, helping cities connect digital initiatives with measurable improvements.
- **Piloting and feedback:** Cities interested in applying or piloting the Guide may be engaged, where feasible, to test selected KPIs, assessment methods and reporting approaches.

This Performance and Impact Assessment Guide is intentionally designed to be technology agnostic, placing people, communities, and the outcomes of digital transformation at its centre rather than prescribing specific technologies or technical architectures. Instead, it focuses on the capabilities enabled by digital transformation, how these capabilities are used, and the value and outcomes they can create for people and urban development. Accordingly, while recognising their critical importance, highly technology-affine domains such as cybersecurity, interoperability, data processing and management, cloud infrastructure, and related technical capabilities are not addressed in detail. These areas involve specialized standards, methodologies, maturity models, and measurement frameworks that warrant dedicated treatment beyond the scope of this Guide. Instead, the Guide focuses on the human, societal, organizational, and outcome-oriented dimensions of digital transformation, enabling it to remain relevant as technologies evolve while providing a durable foundation for assessing meaningful and people-centred digital progress.

Three-Stage Key Performance Indicator (KPI) Approach and High-Level Performance and Impact Assessment Methodology provide cities with a structured set of reference indicators to assess how digital transformation is progressing and, more importantly, what it is achieving for people, communities, and the city as a whole. It offers a flexible basis for performance measurement, allowing cities to adapt indicators, methodologies, and measurement approaches to reflect local circumstances, policy priorities, capacities, and city-based objectives, and maintain consistency, transparency, and comparability across diverse urban contexts.

Cities at earlier stages of digital transformation may adopt a simplified assessment approach, while cities with more advanced data management and analytical capabilities may undertake more detailed assessments. Cities are encouraged to make use of publicly available data and information, where appropriate. Where administrative data are not available, cities may draw on existing programme records, monitoring systems, or periodic representative or sample surveys. Cities shall not be required to establish new data-collection systems solely for the purpose of reporting on the KPIs.

By adopting the Framework, cities can:

- Demonstrate public value and accountability by showing how digital transformation improves quality of life, accessibility, public services, sustainability, resilience, and inclusive economic development.
- Monitor progress and effectiveness by tracking trends, assessing initiatives, and identifying intended outcomes and unintended consequences.
- Identify gaps, risks, and inequalities in access, participation, and outcomes, supporting action to reduce digital divides and promote inclusion.
- Enable benchmarking and peer learning through comparisons with cities of similar characteristics, while allowing flexibility for local priorities and contexts.
- Strengthen long-term planning by aligning digital transformation with urban development objectives, community needs, and sustainable development priorities.
- Promote transparency, trust, and engagement through measurement and communication of progress, outcomes and impacts.

2 People-centred approach

The Performance and Impact Assessment Guide is grounded in a people-centred approach, placing individuals, communities, and their well-being at the heart of digital transformation and sustainable urban development. It recognizes that digital transformation is a means to achieve broader development objectives ensuring that policies, public services, infrastructure, and digital solutions are designed, implemented, and evaluated in response to the needs, rights, aspirations, and diverse circumstances of all people.

A people-centred approach emphasizes universal accessibility, digital inclusion, meaningful public participation, and equitable access to services, with particular attention to women, children and youth, older persons, persons with disabilities, marginalized and underserved communities, and populations facing social, economic, or climate-related vulnerabilities, ensuring that no one is left behind.

The Guide recognizes that digital transformation should generate tangible social, economic, environmental, and institutional benefits alongside technological advancement.

The Framework's Key Performance Indicators (KPIs) provide evidence of how effectively cities leverage digital technologies to create lasting value for people and communities while advancing sustainable urban development.

For instance, the AI and Big Data for Disaster Prediction KPI measures the proportion of natural disasters and climate-related events that are predicted using AI-based models, big data analytics,

and integrated early warning platforms in cities. While this reflects a city's level of digital innovation, its real significance lies in its impact on people. Accurate and timely predictions enable authorities to issue earlier warnings, coordinate emergency responses more effectively, protect vulnerable populations, reduce casualties and economic losses, and strengthen community resilience. In this way, digital technologies become tools for safeguarding lives.

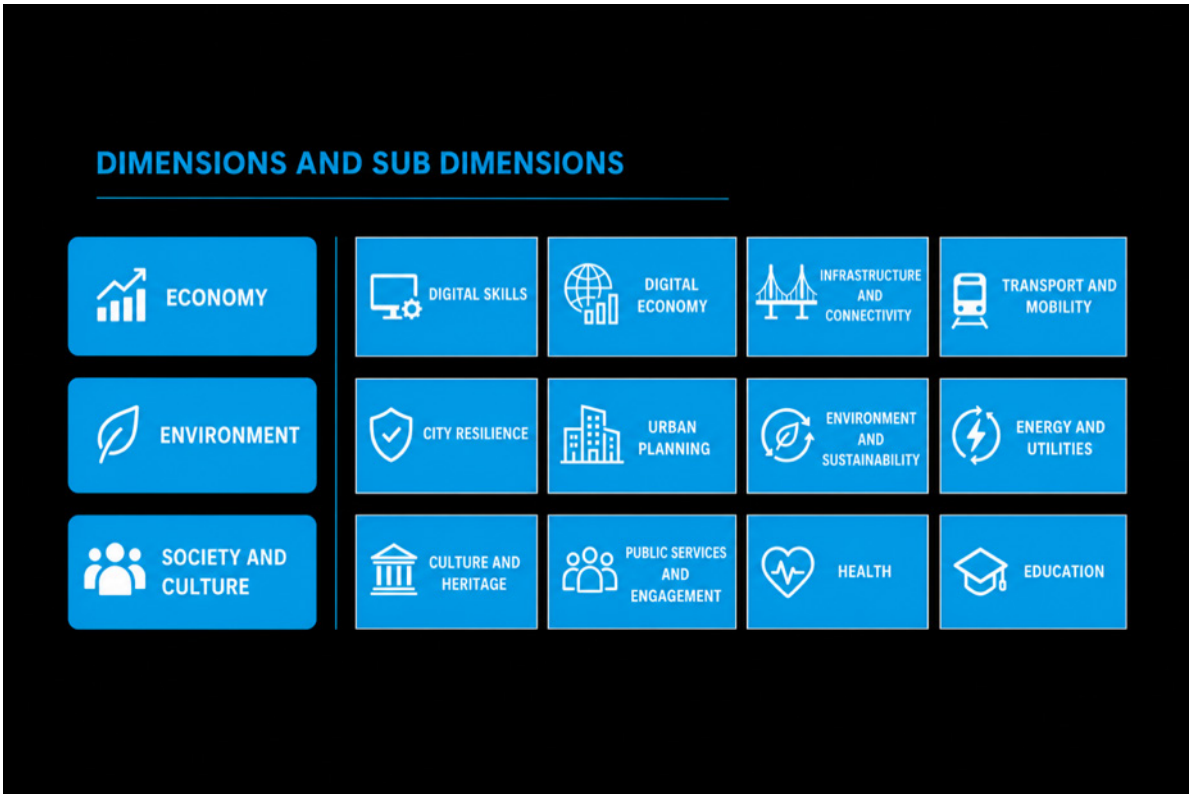
Similarly, the Smart Meters KPI can capture how digital transformation enhances everyday experiences for city residents and businesses. Smart meters provide consumers with greater visibility over their energy consumption, support more accurate billing, enable faster identification of outages, and encourage energy-efficient behaviour. At the same time, utilities benefit from real-time data that improve network management, demand forecasting and resource optimization. The resulting outcomes may include more reliable energy services, lower operational costs, increased sustainability, and more importantly a better quality of life for city residents, demonstrating how digital transformation creates measurable value for both service providers and the communities they serve.



3 Guidance on using the framework in the guide

The Framework provides a structured, multidimensional approach to guide cities toward sustainable, inclusive, and people-centred development. It is organized around three core dimensions, Economy, Environment, Society and Culture and Twelve Subdimensions, offering a comprehensive lens for planning, assessment, and strategic decision-making.

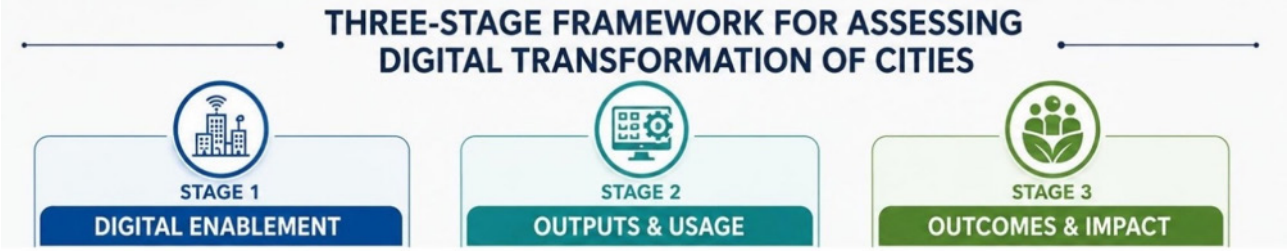
Figure 1: Dimensions and Subdimensions



Source: Author

- **Economy:** Digital Skills, Digital Economy, Infrastructure and Connectivity, Transport and Mobility fostering innovation, accessibility, and economic competitiveness.
- **Environment:** City Resilience, Urban Planning, Environment and Sustainability, Energy and Utilities, promoting sustainable growth, efficient resource use, and long-term resilience.
- **Society and Culture:** Culture and Heritage, Public Services and Engagement, Health, Education, emphasizing social well-being, inclusivity, and human capital development.

Figure 2: Three-Stage Framework for Assessing Digital Transformation



Source: Author

The decision to establish 100 Key Performance Indicators (KPIs) reflects the need to create a Framework that is comprehensive and practical. Although city performance can be assessed through an almost unlimited number of measures, attempting to include every possible indicator would result in an ever-expanding and unmanageable system, reducing clarity, focus and usability.

To ensure a structured and balanced approach, the selected KPIs are organized within a three-stage performance Framework consisting of Digital Enablement, Output/Usage, and Outcome/Impact. Limiting the Framework to 100 carefully selected KPIs ensures that each indicator provides comprehensive coverage across these three interconnected stages. Consequently, the Framework achieves an appropriate balance between breadth and practicality, enabling meaningful performance assessment, benchmarking, and informed decision-making without becoming unnecessarily complex or burdensome.

3.1 (Stage 1): Digital enablement: Assessing digital readiness

The first stage evaluates the enabling conditions required to support the effective planning, implementation, and scaling of digital initiatives. The Key Performance Indicators (KPIs) examine the availability, accessibility, and integration of digital infrastructure, the adoption of foundational digital technologies, and the ability to facilitate inclusive digital participation and engagement.

Assessment at this stage enables cities to identify existing strengths and capacity gaps, prioritize investments, strengthen institutional readiness, and establish the foundations necessary to support inclusive, resilient, and people-centred digital transformation.

3.2 (Stage 2): Outputs and usage: Delivering digital solutions

The second stage focuses on the implementation, adoption, and utilization of digital technologies and services. It assesses the extent to which digital investments are translated into operational capabilities and accessible public services that generate value for residents, businesses, and public institutions. The Key Performance Indicators (KPIs) measure the deployment and utilization of digital services, the integration of digital technologies into municipal operations and service delivery, the adoption of digital solutions by residents and other stakeholders, and improvements in service accessibility, operational efficiency, and innovation.

3.3 (Stage 3): Outcomes and impact: Achieving people-centred results

The third stage evaluates the broader outcomes and long-term impacts of digital transformation on sustainable urban development. It assesses whether digital initiatives contribute to measurable improvements in the well-being of people and the achievement of wider social, economic, environmental and governance objectives.

The Key Performance Indicators (KPIs) monitor outcomes related to quality of life, inclusive and effective governance, economic development, environmental sustainability, resilience, accessibility, digital inclusion, public trust, and city resident satisfaction. By assessing these dimensions, cities can determine whether digital transformation is generating meaningful, equitable, and lasting benefits while supporting local priorities and broader sustainable development objectives.

The three stages also provide a comprehensive assessment pathway that enables cities to understand their level of digital readiness and maturity, and the effectiveness and impact of their digital transformation efforts.

3.4 Flexible and modular framework design

A defining characteristic of the Framework is its modular and adaptable design, which enables cities to apply the assessment according to their individual circumstances, priorities and institutional capacities. Recognizing that cities are at different stages of digital transformation, the Framework does not prescribe a fixed implementation pathway but instead provides a flexible methodology that can be tailored to local needs while maintaining methodological consistency and comparability. Not every digital enablement KPI is directly paired with a corresponding output or outcome KPI. This is intentional, as certain enabling capabilities serve as foundational or cross-cutting prerequisites that support multiple outputs and outcomes rather than mapping to a single measurable result. As a result, the Framework is designed to be non-linear and many-to-many in structure, ensuring flexibility while preserving conceptual coherence. The Framework includes 100 KPIs (core and advanced) rather than a larger number to ensure a balanced, focused, and actionable measurement system that captures the most critical dimensions of people-centred digital transformation without introducing redundancy, excessive complexity, or diminished interpretability.

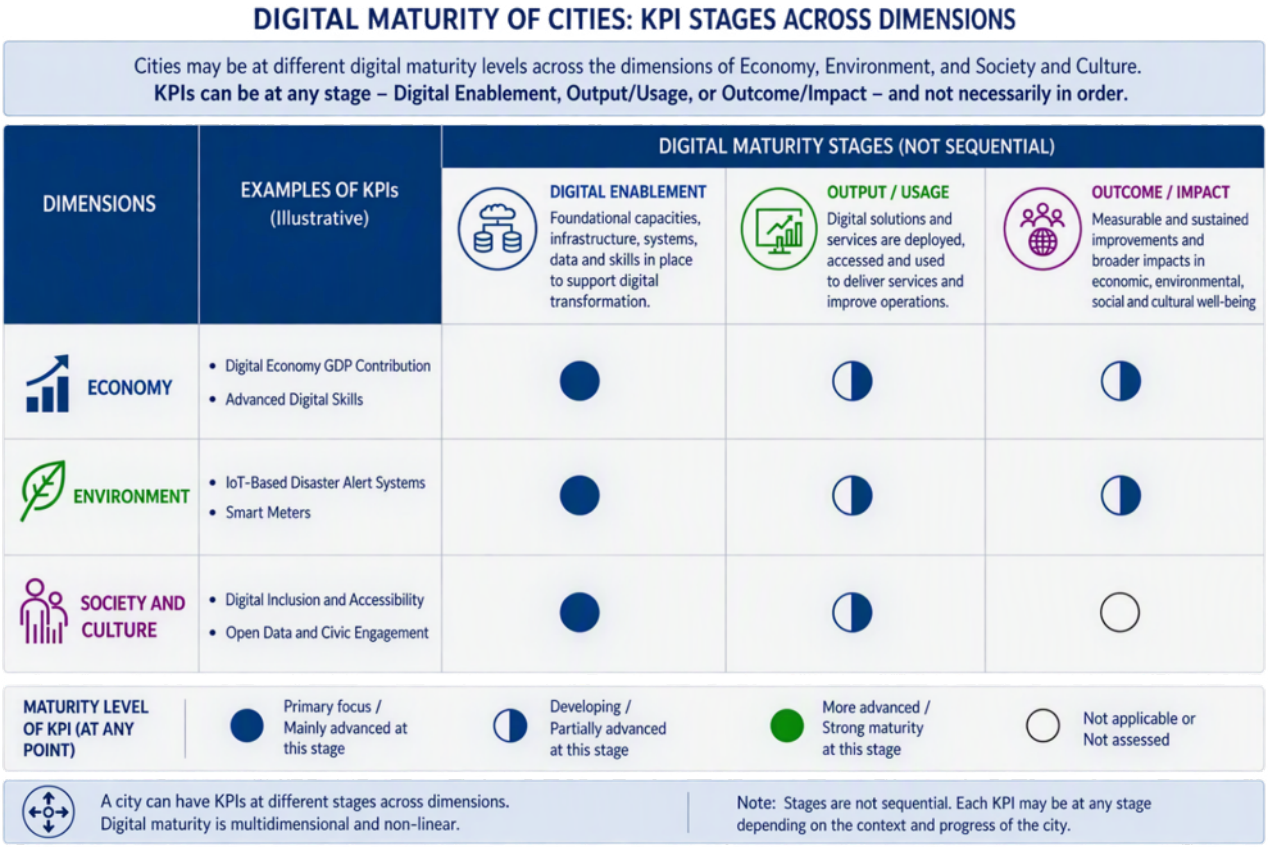
The Performance and Impact Assessment Guide is designed as a holistic yet flexible framework. Cities are not required to implement all KPIs simultaneously. The Framework provides an adaptable set of indicators from which local governments can select those most relevant to their strategic priorities, resources, geographic context, and level of digital maturity. Cities may choose to assess themselves using a focused set of 10–20 core indicators or undertake a more comprehensive assessment. The Framework enables cities to:

- Select individual dimensions, subdimensions, or Key Performance Indicators (KPIs), or apply multiple components in combination, depending on local priorities, policy objectives, and development contexts.

- Assess one, two, or all three stages of the digital transformation process, allowing cities to focus on foundational digital readiness, implementation and usage, long-term outcomes and impacts, or the complete transformation lifecycle based on their digital transformation stage and aspirations.

The effectiveness and successful implementation of the framework will depend on each city's ability to select and apply indicators that are appropriate to its priorities and data-gathering capacity. This flexible and scalable approach enables cities of all sizes and levels of digital maturity to undertake meaningful assessments, benchmark progress over time, support evidence-based decision-making, and continuously strengthen the contribution of digital transformation to sustainable, resilient, inclusive and people-centred urban development.

Figure 3: Digital Maturity of Cities



Source: Author

As illustrated in Figure 3, the examples of Key Performance Indicators (KPIs) are illustrative only and are intended to demonstrate how digital maturity can be considered across the three urban dimensions of Economy, Environment, and Society and Culture. Cities may demonstrate different levels of digital maturity across these dimensions, reflecting the specific characteristics, priorities, capacities, and progress of their digital transformation.

The Framework identifies three stages through which a KPI may reflect digital maturity: Digital Enablement, Output/Usage, and Outcome/Impact. These stages should not be interpreted as sequential or mandatory steps through which every KPI must progress. They represent different ways in which a KPI can capture the role and value of digital transformation.

Digital Enablement focuses on the foundational conditions that support digital transformation, including digital infrastructure, technologies, data systems, platforms, skills, institutional capacities, and other enabling capabilities. Output/Usage focuses on the deployment, adoption, accessibility, and use of digital solutions and services. Outcome/Impact focuses on the measurable and sustained improvements or broader value generated through digital transformation, such as improvements in efficiency, accessibility, service quality, sustainability, resilience, economic performance, social well-being, or quality of life.

Importantly, not every KPI is expected to encompass all three stages. Depending on its purpose, a KPI may primarily address Digital Enablement, Output/Usage, or Outcome/Impact. Some KPIs may appropriately capture one or two stages, while others may provide evidence across all three. For example, a KPI concerned with the availability of digital infrastructure may primarily represent Digital Enablement, whereas a KPI measuring the adoption of a digital service may primarily represent Output/Usage. A KPI measuring the sustained improvement resulting from that service may primarily represent Outcome/Impact.

Therefore, the absence of one or more stages within a KPI does not indicate a deficiency or a lower level of digital maturity. It simply reflects the specific purpose and measurement scope of that KPI. Similarly, the illustrative KPI examples in Figure 3 shall not be understood as prescribing a fixed classification or progression for all cities or all KPIs.

Digital maturity shall consequently be understood as multidimensional and non-linear. A city may have relatively advanced digital capabilities in one urban dimension while remaining at an earlier stage in another, and it may simultaneously demonstrate Digital Enablement, Output/Usage, and Outcome/Impact at different levels across different areas.

4 Definition of Core and Advanced Key Performance Indicators (KPIs)

The Framework distinguishes between two categories of indicators:

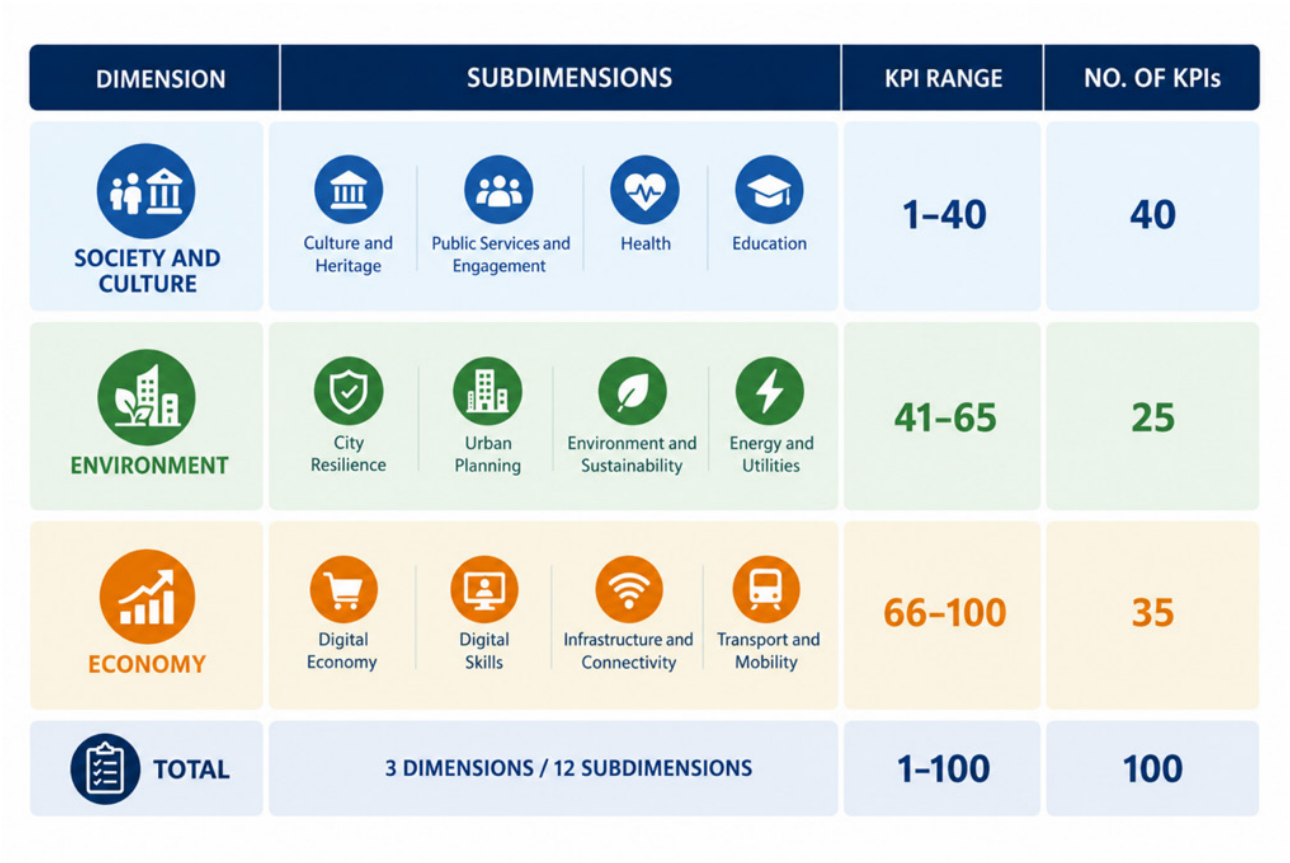
Core KPIs represent a standardized set of indicators that are applicable to all cities, regardless of their size, level of development, or institutional capacity. They establish a common baseline for assessing digital transformation by measuring fundamental aspects such as digital infrastructure, digital public services, technology adoption, service utilization, governance, accessibility, and the initial outcomes of digital transformation. Core KPIs provide the foundation for consistent performance monitoring and facilitate benchmarking across diverse urban contexts. There are 66 Core KPI's.

Advanced KPIs are intended for cities with more mature digital ecosystems and greater institutional capacity. These indicators assess more sophisticated dimensions of digital transformation, including the integration of emerging technologies such as artificial intelligence, predictive and data-driven public service delivery, and more comprehensive assessments of social inclusion, equity, resilience, sustainability, and long-term impact. There are 34 Advanced KPIs.

KPIs shall, where possible, be calculated using existing and reliable data from municipal, national or regional administrative systems, monitoring networks, GIS databases, utility records, surveys, publicly available sources and other relevant sources. Cities shall not be required to establish new data-collection systems solely for reporting. Where data are managed at the national or regional level, cities may use data covering the relevant geographic area, subject to appropriate data-sharing and governance arrangements.

Cities are encouraged to adopt a progressive implementation approach by initially applying the Core KPIs to establish a baseline assessment of their digital transformation performance. As institutional capabilities, data availability, governance arrangements, and digital ecosystems evolve, cities may progressively incorporate Advanced KPIs to undertake more comprehensive performance and impact assessments. Regardless of their level of digital maturity or stage of development, urban and rural communities are both encouraged to apply the Framework in a manner that ensures digital transformation remains people-centred and contributes to inclusive, equitable, resilient, and sustainable development, in alignment with the principle of leaving no one behind.

Figure 4: Digital Transformation Assessment Framework



Source: Author

Figure 4 outlines the interconnected pillars: Society and Culture, Environment, and Economy, supported by clearly defined subdimensions and a total of 100 KPIs distributed across these areas. It strongly embodies a people-centred perspective by placing social well-being, access to public services, health, education, and cultural engagement at its core, while aligning environmental sustainability and economic progress with the needs and quality of life of people. The Framework places people at the centre of digital transformation by prioritizing the Society and Culture dimension, which comprises 40 of the 100 KPIs covering Culture and Heritage, Public Services and Engagement, Health, and Education.

5 Key Performance Indicator Template

The KPI template is designed to make the Framework practical and straightforward for cities to implement. Each Key Performance Indicator (KPI) within the Framework is defined provides a clear definition, rationale and interpretation, methodology, unit of measurement, benchmarking guidance, and identified data sources/relevant databases, enabling cities to understand what needs to be measured, how it shall be measured, and where the required information can be obtained.

This level of specification helps minimize ambiguity and additional data-collection burdens while supporting consistent and comparable reporting across cities.

Each KPI is uniquely identified through a KPI number and KPI name, and is further classified by category (Core or Advanced), reflecting its level of methodological maturity and applicability across different stages of digital transformation.

The stage of KPI specifies whether it relates to Digital Enablement, Output/Usage, or Outcome/Impact, thereby clarifying the dimension and stage of digital transformation being assessed. This classification ensures a structured understanding of whether the KPI measures foundational readiness, service delivery performance, or broader socio-economic and environmental outcomes.

The definition/description provides a clear and precise explanation of what the KPI measures, ensuring common understanding and consistency in application across cities and stakeholders. The rationale/interpretation explains the relevance of the indicator within the context of digital transformation and sustainable urban development, and provides guidance on how results should be interpreted in relation to policy objectives and urban development priorities.

The methodology sets out the approach for calculating or measuring the KPI, including any relevant formulas, data collection methods, or analytical procedures.

The unit of measurement ensures standardization and comparability of results across different cities and time periods.

The benchmarking component provides a reference point for performance comparison, enabling cities to assess their progress against defined targets, international standards, or peer city performance, where applicable. This supports continuous improvement, evidence-based planning, and performance evaluation.

Finally, sources/references and data sources/relevant databases identify the origin of the data and the systems used for data collection and validation. This ensures transparency, reliability, traceability, strengthening the credibility of the assessment process.

6 Key Performance Indicator Table

	Dimension	Subdimension	KPI Name	Stage	Category
1.	Society and Culture	Culture and Heritage	Availability of Digital Cultural Content	Digital Enablement	Core
2.	Society and Culture	Culture and Heritage	Engagement with Digital Cultural Content	Output/Usage	Core
3.	Society and Culture	Culture and Heritage	Satisfaction with Digital Cultural Content	Outcome/Impact	Core

	Dimension	Subdimension	KPI Name	Stage	Category
4.	Society and Culture	Public Services and Engagement	Digital Public Services Availability	Digital Enablement	Core
5.	Society and Culture	Public Services and Engagement	Digital Inclusion and Accessibility	Digital Enablement	Core
6.	Society and Culture	Public Services and Engagement	Open Data and Civic Engagement	Digital Enablement	Advanced
7.	Society and Culture	Public Services and Engagement	Digital Civic Participation	Output/Usage	Core
8.	Society and Culture	Public Services and Engagement	Digital Service Delivery and Adoption	Output/Usage	Core
9.	Society and Culture	Public Services and Engagement	Open Data Usage	Output/Usage	Core
10.	Society and Culture	Public Services and Engagement	Digital Participation in Policymaking	Output/Usage	Core
11.	Society and Culture	Public Services and Engagement	Equity and Inclusivity in Digital Engagement	Output/Usage	Advanced
12.	Society and Culture	Public Services and Engagement	Satisfaction with Digital Public Services	Outcome/Impact	Core
13.	Society and Culture	Public Services and Engagement	Sustainability Benefits	Outcome/Impact	Core
14.	Society and Culture	Public Services and Engagement	Inclusive Access to Digital Public Services	Outcome/Impact	Advanced
15.	Society and Culture	Public Services and Engagement	Open Data Usage in Policy and Research	Output/Usage	Core
16.	Society and Culture	Public Services and Engagement	Satisfaction with Open Data	Outcome/Impact	Core
17.	Society and Culture	Public Services and Engagement	Involvement in Public Sector Investment Decisions	Output/Usage	Advanced
18.	Society and Culture	Public Services and Engagement	Public Trust in Digital Governance	Outcome/Impact	Core

	Dimension	Subdimension	KPI Name	Stage	Category
19.	Society and Culture	Public Services and Engagement	Evidence-Based Policymaking	Output/Usage	Advanced
20.	Society and Culture	Health	Digital Health Services Availability	Digital Enablement	Core
21.	Society and Culture	Health	Electronic Health Records	Digital Enablement	Core
22.	Society and Culture	Health	Tele-Health Adoption and Utilization	Digital Enablement	Core
23.	Society and Culture	Health	Public Access to Electronic Health Records	Digital Enablement	Core
24.	Society and Culture	Health	Digital Transformation in Healthcare Institutions	Digital Enablement	Core
25.	Society and Culture	Health	Digital Assistive Living	Digital Enablement	Advanced
26.	Society and Culture	Health	Teleconsultation Utilization Rate	Output/Usage	Core
27.	Society and Culture	Health	Telemedicine Usage by Patients	Output/Usage	Core
28.	Society and Culture	Health	Technological Coverage of Vulnerable Households	Outcome/Impact	Advanced
29.	Society and Culture	Health	Satisfaction with Digital Health Services	Outcome/Impact	Core
30.	Society and Culture	Health	Telemedicine Experience and Satisfaction	Outcome/Impact	Advanced
31.	Society and Culture	Health	Caregiver Well-being and Burden Reduction	Outcome/Impact	Advanced
32.	Society and Culture	Health	Autonomy and Independence in Assisted Living	Outcome/Impact	Advanced
33.	Society and Culture	Education	Student Access to ICT Infrastructure	Digital Enablement	Core
34.	Society and Culture	Education	Digital Pedagogy and Educator Readiness	Digital Enablement	Core
35.	Society and Culture	Education	Adoption of Emerging Technologies in Education	Digital Enablement	Advanced
36.	Society and Culture	Education	Equitable Digital Access for Marginalized Learners	Digital Enablement	Advanced
37.	Society and Culture	Education	Connectivity Infrastructure in Underserved Educational Settings	Digital Enablement	Core
38.	Society and Culture	Education	Digital Access and Learning Engagement	Output/Usage	Core

	Dimension	Subdimension	KPI Name	Stage	Category
39.	Society and Culture	Education	Digital Content Consumption	Output/Usage	Core
40.	Society and Culture	Education	Digital Equity Index	Output/Usage	Advanced
41.	Environment	City Resilience	Environmental Sustainability and Urban Resilience	Digital Enablement	Core
42.	Environment	City Resilience	AI and Big Data for Disaster Prediction	Digital Enablement	Advanced
43.	Environment	City Resilience	IoT-Based Disaster Alert Systems	Output/Usage	Core
44.	Environment	City Resilience	Disaster Response and Impact Reduction	Outcome/Impact	Advanced
45.	Environment	Urban Planning	Data-Driven Urban Governance	Output/Usage	Advanced
46.	Environment	Environment and Sustainability	Environmental Monitoring and Public Health	Digital Enablement	Advanced
47.	Environment	Environment and Sustainability	Smart Energy and Grid Management	Digital Enablement	Advanced
48.	Environment	Environment and Sustainability	Urban Noise Management	Digital Enablement	Advanced
49.	Environment	Environment and Sustainability	Water Quality	Digital Enablement	Advanced
50.	Environment	Environment and Sustainability	Circular Economy and Waste Reduction	Output/Usage	Core
51.	Environment	Environment and Sustainability	Real-Time Renewable Energy Monitoring	Digital Enablement	Advanced
52.	Environment	Environment and Sustainability	Change in Air Pollution	Outcome/Impact	Core
53.	Environment	Environment and Sustainability	Clean Energy Production	Outcome/Impact	Core
54.	Environment	Environment and Sustainability	Sustainable Last Mile Logistics	Outcome/Impact	Advanced
55.	Environment	Energy and Utilities	Smart Grid Infrastructure and Control	Digital Enablement	Core

	Dimension	Subdimension	KPI Name	Stage	Category
56.	Environment	Energy and Utilities	Smart Buildings	Digital Enablement	Core
57.	Environment	Energy and Utilities	Smart Meters	Digital Enablement	Core
58.	Environment	Energy and Utilities	Drinking Water Infrastructure	Digital Enablement	Core
59.	Environment	Energy and Utilities	Smart Water Meter Penetration Rate	Digital Enablement	Core
60.	Environment	Energy and Utilities	Reduction in Electricity Consumption	Output/Usage	Core
61.	Environment	Energy and Utilities	Electricity Reliability Measures (SAIDI, SAIFI, CAIDI)	Output/Usage	Core
62.	Environment	Energy and Utilities	Water Consumption	Outcome/Impact	Core
63.	Environment	Energy and Utilities	Electricity Transmission and Distribution Losses	Outcome/Impact	Core
64.	Environment	Energy and Utilities	Change in Water Consumption	Outcome/Impact	Core
65.	Environment	Energy and Utilities	Reduction in Water Transmission and Distribution Losses	Outcome/Impact	Core
66.	Economy	Digital Economy	Online Presence	Output/Usage	Core
67.	Economy	Digital Economy	Digital Payments	Digital Enablement	Core
68.	Economy	Digital Economy	Workforce Digital Skills	Digital Enablement	Core
69.	Economy	Digital Economy	Online Businesses (adoption-based)	Digital Enablement	Core
70.	Economy	Digital Economy	Online Procurement (adoption-based)	Digital Enablement	Core
71.	Economy	Digital Economy	Patents	Outcome/Impact	Core
72.	Economy	Digital Economy	Digital Payments Usage	Output/Usage	Core
73.	Economy	Digital Economy	Business Electronic Invoices	Output/Usage	Core
74.	Economy	Digital Economy	Digital Tax Fillings	Output/Usage	Core
75.	Economy	Digital Economy	Online Retail Sales	Output/Usage	Core

	Dimension	Subdimension	KPI Name	Stage	Category
76.	Economy	Digital Economy	Online Procurement (value-based)	Output/Usage	Core
77.	Economy	Digital Economy	Digital Economy GDP Contribution	Outcome/Impact	Advanced
78.	Economy	Digital Skills	Advanced Digital Skills	Digital Enablement	Advanced
79.	Economy	Digital Skills	Digital Literacy Training in Disadvantaged Areas	Digital Enablement	Advanced
80.	Economy	Digital Skills	Disadvantaged Areas with Broadband	Digital Enablement	Core
81.	Economy	Digital Skills	Digital Device Ownership	Output/Usage	Core
82.	Economy	Digital Skills	Digital Inclusion and Equity	Outcome/Impact	Core
83.	Economy	Infrastructure and Connectivity	Household Fixed Broadband Availability	Digital Enablement	Core
84.	Economy	Infrastructure and Connectivity	Broadband Service Affordability	Digital Enablement	Advanced
85.	Economy	Infrastructure and Connectivity	5G Network Availability	Digital Enablement	Advanced
86.	Economy	Infrastructure and Connectivity	Public Wi-Fi Coverage	Digital Enablement	Core
87.	Economy	Infrastructure and Connectivity	Fixed (Wired) Broadband Subscriptions	Output/Usage	Advanced
88.	Economy	Infrastructure and Connectivity	Wireless Broadband Subscriptions	Output/Usage	Advanced
89.	Economy	Infrastructure and Connectivity	5G Usage	Output/Usage	Advanced
90.	Economy	Infrastructure and Connectivity	Wi-Fi Usage	Output/Usage	Core
91.	Economy	Infrastructure and Connectivity	Broadband Internet Satisfaction	Outcome/Impact	Core

	Dimension	Subdimension	KPI Name	Stage	Category
92.	Economy	Infrastructure and Connectivity	5G Services Satisfaction	Outcome/Impact	Advanced
93.	Economy	Transport and Mobility	Smart Mobility and Transport Monitoring	Digital Enablement	Core
94.	Economy	Transport and Mobility	Public Transport Stops	Digital Enablement	Core
95.	Economy	Transport and Mobility	Digital Payment System for Public Transport	Digital Enablement	Core
96.	Economy	Transport and Mobility	Urban Traffic Monitoring and Alert Systems	Digital Enablement	Core
97.	Economy	Transport and Mobility	Advanced Transit Management System	Digital Enablement	Advanced
98.	Economy	Transport and Mobility	Smart Intersection Management	Digital Enablement	Core
99.	Economy	Transport and Mobility	Public Transit Usage	Outcome/Impact	Advanced
100.	Economy	Transport and Mobility	Traffic Time Index	Outcome/Impact	Advanced

7 A Review of Current Methodologies and Indices

There are several initiatives, indices and rankings in place to provide information to countries pertaining to their digital transformation progress, or for specific areas of digital transformation.

8 Measurement and Impact

In addition to performance monitoring through the three-staged KPI system, the Framework includes an optional Impact Assessment Tool aligned with ITU Recommendation Y.4905. This tool enables cities to undertake a more comprehensive assessment of the social, environmental, economic, and governance impacts of digital transformation, complementing performance measurement by identifying broader systemic outcomes, unintended effects, and opportunities for improvement that may not be captured through operational indicators alone.

The Impact Assessment Tool is intended to support evidence-based evaluation and continuous learning, providing cities with additional insights to inform policy development, strategic planning, and investment decisions. It will be made available upon completion of the study for cities that choose to adopt it. Use of the tool is entirely voluntary and is not a prerequisite for applying the Framework or participating in its implementation.

9 Digital Transformation Impact Assessment

Purpose and context

This section establishes a structured, pragmatic, and international standards aligned approach for conducting impact assessments of digital transformation at the city or community level. The approach is grounded in the principles and methodology set out in *ITU-T Recommendation Y.4905: Smart Sustainable City Impact Assessment*, and is intended to support evidence-based decision-making, accountability, and continuous improvement in digital transformation programs. The Digital Transformation Impact Assessment (DTIA) enables cities and communities to systematically evaluate the social, economic, and environmental impacts of digital transformation by leveraging defined Digital Transformation Key Performance Indicators (KPIs). The objective of this assessment is to quantify and qualify the effects of digital transformation using specific Key Performance Indicators (KPIs). It ensures that the benefits, tradeoffs, and risks associated with digital transformation are identified, measured, and managed in a transparent manner.

Guiding principles

The impact assessment methodology is guided by the following principles:

- **Pragmatism and proportionality**: The scope and depth of the assessment should be commensurate with the scale, complexity, and risk profile of the identified scope.
- **Evidence-based analysis**: Assessments shall be grounded in reliable qualitative and quantitative data, supported by clearly documented sources and assumptions.
- **Multidimensional impact**: Social, economic, and environmental aspects shall be considered for impact assessment.
- **Transparency and verifiability**: Methods, data sources, and analytical approaches shall be documented and made available for verification.
- **Stakeholder inclusiveness**: Relevant stakeholders shall be identified and engaged throughout the assessment process, where appropriate.

Impact Assessment Methodology

The Digital Transformation Impact Assessment can be conducted through the following four sequential pragmatic steps.

Figure 5: Impact Assessment Steps



Source: Author

9.1 (Step 1): Impact assessment scoping

The first step establishes the scope and boundaries of the impact assessment. Clear scoping is essential to ensure focus, comparability, and efficient use of resources.

Geographical Boundaries

Cities and communities shall define the geographical scope of the impact assessment. This may include, but is not limited to:

- The entire city or metropolitan area
- A specific region, district, or corridor
- A local area, community, or pilot zone

The selected geographical boundary shall be explicitly documented and justified in relation to the objectives of digital transformation.

Digital Transformation KPIs

Cities shall identify the Digital Transformation KPIs to be included in the impact assessment. For each selected KPI, cities shall determine the measurement approach, choosing one of the following:

- **Nominal (actual) KPI values**: These represent the city's current position or performance level with respect to the KPI.

- **Delta (change) KPI values**: These represent the difference between a defined baseline value and the achieved value, thereby capturing improvements attributable to digital transformation.

The use of nominal values is appropriate where the objective is to assess the current state or maturity of the city. The use of delta values is appropriate where the objective is to assess improvements or outcomes resulting specifically from digital transformation interventions.

Impact Types

For each KPI included in the assessment, cities shall determine the relevant impact types to be assessed. Impact types shall be categorized as:

- **Social impacts** (e.g., quality of life, accessibility, inclusion, trust, safety)
- **Economic impacts** (e.g., productivity, cost efficiency, competitiveness, investment attraction)
- **Environmental impacts** (e.g., resource efficiency, emissions reduction, environmental sustainability)

A KPI may contribute to one or multiple impact types. It is recognized that the complexity, duration, and resource requirements of the impact assessment increase as additional KPIs and impact types are included. Figure 6 illustrates a simple approach for scoping KPIs.

Figure 6: Illustrative Scoping Approach

KPI	Included (Y/N)	Social Impact (Y/N)	Economic Impact (Y/N)	Environmental Impact (Y/N)
Digital transformation KPI 1	☐ *If yes, please indicate Nominal or Difference*	☐	☐	☐
Digital transformation KPI 2	☐ *If yes, please indicate Nominal or Difference*	☐	☐	☐
…	…	☐	☐	☐
Digital transformation KPI N	☐ *If yes, please indicate Nominal or Difference*	☐	☐	☐

ⓘ **Note:** Y/N = Yes / No

Source: Author

9.2 (Step 2): Identification of impact aspects

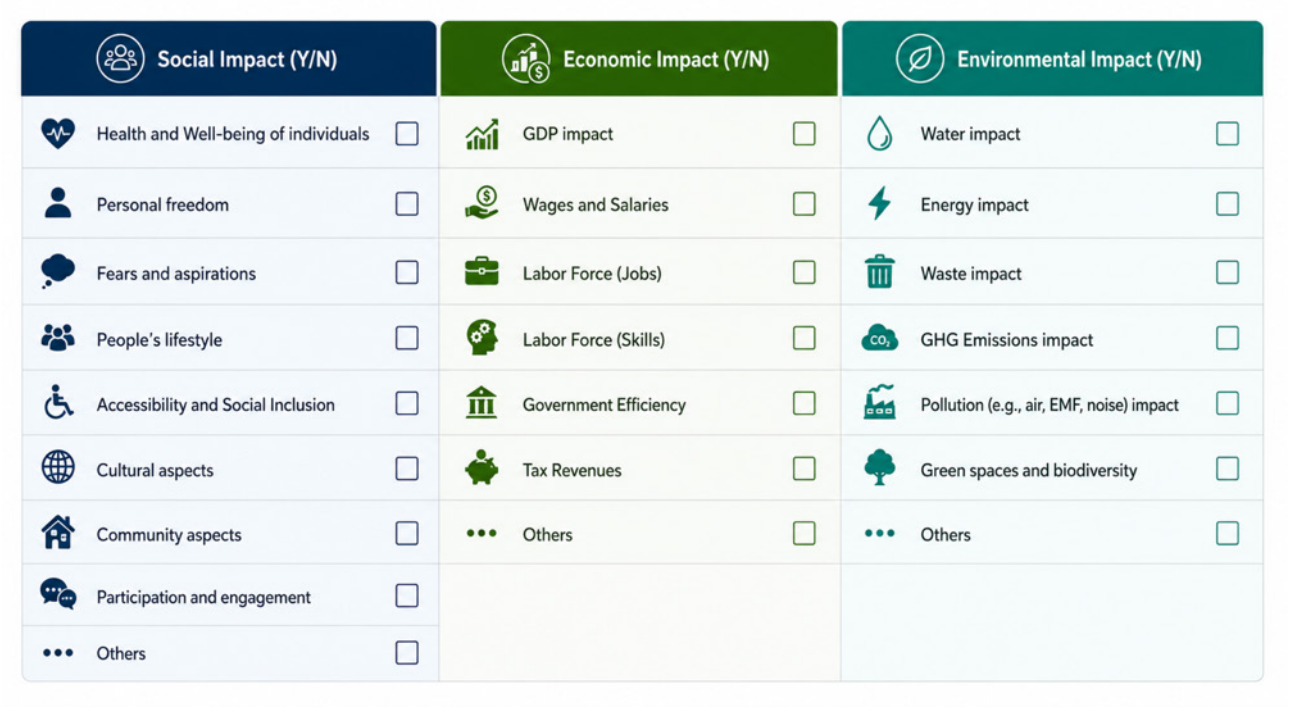
In this step, cities shall identify the specific social, economic, and environmental aspects that will be covered by the impact assessment.

This includes:

- Defining the thematic areas within each impact type (e.g., social inclusion, economic growth, environmental efficiency)
- Ensuring alignment between selected aspects and the defined KPIs

Figure 7 illustrates a simple approach for identifying impact aspects. The identified aspects should provide a coherent analytical framework that links digital transformation to measurable outcomes and impacts. Cities and communities can include other aspects as they deem beneficial and/or essential, in addition to the specified aspects.

Figure 7: Illustrative Identification of Impact Aspects



Source: Author

9.3 (Step 3): Conduct of the impact assessment and data collection

Cities and communities shall determine and conduct the research and analyses required to assess the defined impacts. This step may involve both qualitative and quantitative methods.

9.3.1 Research Methods and Tools

Appropriate research tools and techniques may include, but are not limited to:

- Surveys and questionnaires
- Interviews and focus groups
- Administrative and operational data analysis
- Quantitative modelling and statistical analysis
- Economic impact assessment models, where applicable

Survey responses shall be aggregated into structured datasets, cleansed and tabulated for further analysis. Qualitative data collected through interviews and focus groups shall be systematically analyzed to identify recurring themes, trends, issues, and evidence-based conclusions.

Where feasible and relevant, quantitative modelling techniques shall be employed to estimate impacts, particularly in the economic domain.

9.3.2 Stakeholder Identification

Cities shall identify appropriate stakeholders for participation in field research and analyses. Depending on the scope of the assessment, stakeholders may include:

- Government and public sector entities
- Private sector organizations
- Non-governmental and civil society organizations
- Academic and research institutions
- Members of the public and individual users

9.3.3 Use of Third Parties

In certain cases, cities and communities may engage independent third parties, such as research institutions or consulting organizations, to conduct all or part of the impact assessment. This may be appropriate where specialized expertise, independent validation, or extensive data collection and analysis are required.

9.3.4 Data Sources and Documentation

Data sources shall be identified in advance and may include both primary and secondary data sources. The selection of data used for the impact assessment shall be documented and made available for verification.

9.3.5 Resource Planning

Cities and communities shall plan and allocate adequate human and financial resources to support the required field research and analyses. Budget planning shall reflect the scope, complexity, and methodological requirements of the assessment.

9.4 (Step 4): Impact evaluation and mitigation

Following the completion of data collection and analysis, cities and communities shall identify and evaluate the potential impacts arising from the digital transformation initiative(s).

9.4.1 Impact Evaluation

Cities and communities shall assess the relative significance and importance of identified impacts, taking into account their magnitude, likelihood, distribution across stakeholders, and alignment with strategic objectives.

9.4.2 Mitigation Measures

Where adverse or unintended impacts are identified, cities and communities shall determine appropriate mitigation measures. The objective of mitigation is to avoid, accept, reduce, or minimize adverse impacts while maintaining and enhancing positive impacts.

Cities and communities shall determine one or more of the following mitigation approaches:

1. **Accept potential impacts**: Cities and communities may accept the identified impacts and proceed with implementation as planned.
2. **Reduce adverse impacts where feasible**: Cities and communities may modify elements of digital transformation through redesign, policy and regulatory measures, improved communication, or alternative implementation approaches to reduce adverse impacts.
3. **Monitor impacts**: Cities and communities may accept impacts but monitor them during implementation to ensure they materialize as anticipated. Monitoring enables timely corrective actions in response to unforeseen effects.
4. **Avoid impacts**: In exceptional cases, cities and communities may decide not to implement the initiative, or parts thereof, where adverse impacts are deemed unacceptable.

9.4.3 Use of positive impacts

Identified positive impacts can be used to communicate the benefits of digital transformation to stakeholders. In particular, documented positive economic impacts may support the justification for public funding, external financing, or investment decisions.

9.4.4 Continuous improvement

The Digital Transformation Impact Assessment shall not be treated as a one-time exercise. Cities and communities are encouraged to periodically revisit, and update impact assessments as digital transformation initiatives mature, data quality improves, and contextual conditions evolve, thereby supporting continuous learning and improvement in digital transformation governance.

10 Conclusion

The Performance and Impact Assessment Guide provides a structured and practical approach for assessing the progress, performance, and impact of digital transformation initiatives. It comprises two complementary components:

1. A three-stage Key Performance Indicator (KPI) Framework, which measures the performance and readiness of digital transformation across multiple dimensions;
2. A High-Level Performance and Impact Assessment Methodology, which evaluates the broader outcomes and long-term impacts of digital transformation on people, communities, and sustainable urban development.

It promotes a balanced assessment across social, environmental and economic dimensions, so ensuring that digital transformation contributes to inclusive, sustainable, resilient and people-centred urban development. In addition to the core KPI structure, an Impact Assessment component is included as an optional analytical tool, enabling cities to more deeply evaluate the outcomes and longer-term effects of digital transformation policies and interventions where data availability and analytical capacity allow.

Overall, the Guide is designed to be flexible and adaptable to local contexts while maintaining consistency in measurement. It enables cities to track progress over time, strengthen accountability, and share good practices across jurisdictions, while also providing an enhanced layer of insight through optional impact evaluation where applicable.

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Appendix 1: Key performance indicator template

Dimension			
Subdimension			
KPI No			
KPI Name			
Category • Core • Advanced		Stage: • Digital Enablement • Output/Usage • Outcome/Impact	
Definition/ Description			
Rationale/ Interpretation			
Methodology			
Unit			
Benchmarking			
Source (s)/ References			
Data Sources/ Relevant Databases			

Appendix 2: A sample of data collection template

A Sample of Data Collection Template (Optional)

KPI No.		KPI Name	

Dimension	Subdimension	Stage

DATA / VALUE

PERIOD (Year/Quarter/Month, etc.)	DATA SOURCE

COMMENTS

INSTRUCTIONS FOR CITIES

For each KPI, cities are requested to provide:

- **Data / Value:** Enter the available value for the KPI, in accordance with the unit and calculation method provided in the Guide.
- **Period:** Indicate the period to which the data relates.
- **Data Source:** Indicate the source from which the data was obtained, such as a government database, administrative records, survey, report, or other official source.
- **Comments:** Provide any relevant information, including data limitations, methodology differences, estimates, or partial availability.

If data are not available, enter "Not available" in the Data / Value field and, where possible, briefly explain why in Comments.

Note: The KPI definition, calculation method, unit, dimension, subdimension, and stage are provided in the Guide. Cities do not need to provide or define these fields themselves.


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