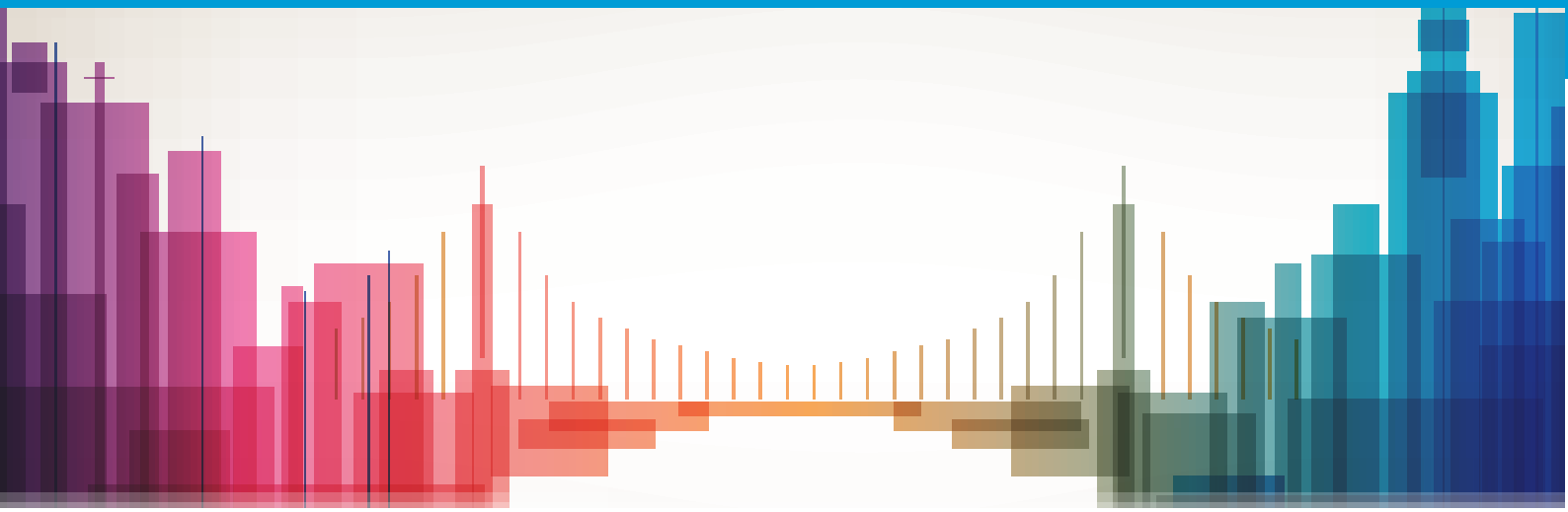
United 4 Smart Sustainable Cities

Guiding principles for artificial intelligence in cities



Convention on Biological Diversity

United Nations ECLAC

Food and Agriculture Organization of the United Nations

UNIDO

ITU

UNDP

United Nations Economic Commission for Africa

UNECE

United Nations Educational, Scientific and Cultural Organization

UNEP

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United Nations Framework Convention on Climate Change

UN-HABITAT FOR A BETTER URBAN FUTURE

United Nations Department of Economic and Social Affairs

UN OFFICE 4 PARTNERSHIPS

UNU EGOV

UNWTO World Tourism Organization

UN WOMEN

WORLD METEOROLOGICAL ORGANIZATION

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Foreword

This publication was developed within the framework of the United for Smart Sustainable Cities (U4SSC) initiative.

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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 any digital technology. It advocates for policies encouraging responsible use of ICTs that contribute to the economic, environmental, and social sustainability as well as the advancement of the 2030 Agenda for Sustainable Development. The study conducted in this report is based on extensive literature review and voluntary written contributions from stakeholders.

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List of abbreviations

Abbreviation	Full form
AI	Artificial Intelligence
BAAI	Beijing Academy of Artificial Intelligence
ML	Machine Learning
NGOs	Non-Governmental Organizations
PPPP	Public-private-people partnership
SSCs	Smart Sustainable Cities

Executive summary

The United for Smart Sustainable Cities (U4SSC) initiative is a leading platform for supporting smart sustainable cities worldwide. The U4SSC is coordinated by the International Telecommunication Union (ITU), the United Nations Economic Commission for Europe (UNECE) and the United Nations Human Settlement Programme (UN-Habitat) along with the support of other 16 United Nations agencies and programmes and has developed strategic guidelines and tools that aim to assist prospective smart sustainable cities in implementing the Sustainable Development Goals (SDGs).

The Guiding Principles for AI in Cities provides a broad set of suggested principles, enablers, governance methods, policy instrument alternatives and a simple methodology for instilling AI principles in cities.

The first section provides a brief introduction to urbanization and its high-level challenges. The second section emphasizes the significance of AI principles for ethical use of AI in cities. It also clarifies the scope of this document. The third section contains a set of principles which cities can employ in their AI implementations.

The fourth section encompasses four categories of enablers which cities can utilize to help in their AI principles implementation. The fifth section introduces governance alternatives of regulatory, executive and compliance roles for AI principles implementation.

The sixth section provides policy instrument alternatives for implementing AI principles in cities. The seventh section provides a simple four step methodology for implementing AI principles in cities. Last, but not the least, the eighth section concludes with some observations for AI principles implementations in real life.

1 Introduction

Urbanization is progressing at an unprecedented rate, with 68 per cent of the world population expected to reside in urban areas by 2050.[1] Ninety-five per cent of the urban expansion is expected to take place in the developing world, putting tremendous pressure on these regions to cope with the new human development challenges. It is important to address the rising challenges for urban governance including, but not limited to, economic inclusiveness, increased resource consumption, environmental deterioration, seamless and convenient mobility, surging housing needs, new physical infrastructure, and city resilience.

In this context, Artificial Intelligence (AI) is a frontier technology that can be leveraged to assist with decision-making to help address various urban challenges faced by cities across the globe. Increasingly, people and objects in cities are connecting to the Internet and generating huge amounts of data thanks to digitalization. AI presents an unprecedented opportunity to learn to solve urban problems and, by capitalizing on algorithms and urban data, to automate decision-making at a speed and scale that is not possible for humans.

AI and machine learning (ML):

- can be used to identify, address, and solve a myriad of **municipal challenges and problems;**
- use **data** extensively; and
- enable **algorithms to be revised** and to improve over time by **utilizing additional data as a learning mechanism** as it becomes available.

[1] https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

2 Guidance for artificial intelligence (AI)

AI, almost intrinsically, delegates human tasks to machines (e.g., computers) and in some cases completely replaces them (e.g., autonomous systems). Therefore, it is important and imperative to achieve assurance in AI systems for their proper functioning.

In this document, a set of guiding principles is included to design, develop and deploy AI systems. These principles effectively manifest and express the values cities need to instil to achieve a trustworthy and safe AI based smart sustainable city services. The combination of target AI principles selected by cities constitutes a specific direction and focus for their AI systems.

The successful implementation of AI principles may not be guaranteed, and cities will need to exert additional efforts to ensure their compliance in AI systems. However, these additional efforts will render AI systems more reliable and trustworthy in urban contexts.

The Scope of this Document: It is important to mention that this document:

- is intended to be used by city administrations that aim to develop and implement guiding principles for AI in their urban contexts. Therefore, it targets smart and sustainable cities and communities;
- is NOT about identifying a comprehensive list of AI solutions in smart sustainable cities (SSCs). It is rather about providing principles-based guidance in using AI for SSCs. AI use case examples are mentioned in the document; however, it would be practically impossible to exhaustively identify all AI use cases in a city context;
- can be used by all aspiring cities that aim to implement AI solutions regardless of their size and context;
- is technology agnostic within the context of overall AI technologies; and
- is a framework document that can be adopted by cities and tailored to their own specific needs and contexts. In addition to guiding principles, it also provides a non-exhaustive list of enablers, which can be used selectively by cities to accelerate the implementation of their AI principles. A short list of policy instrument alternatives and governance options are also included to help cities adopt AI principles.

3 AI principles framework

Artificial Intelligence, as a frontier technology, is used in urban contexts to address various city challenges. These can include areas such as hiring, utilities, transportation, cybersecurity and tourism. Today, undoubtedly Artificial Intelligence already facilitates the lives of people in various contexts and applications. However, as with all other erstwhile technologies, it also brings its own risks and pitfalls.

In this context, this guide presents a principles framework that cities can use for their own AI systems. The framework is flexible to accommodate cities' particular goals and objectives by allowing them to select their own principles from a relatively rich set of potential principles. The implementation of these principles is important to achieve intended outcomes from AI systems in cities.

The AI principles framework developed in this guide aims to establish a list of AI principles as mutually exclusive and collectively exhaustive as possible. The first section provides a general overview of existing initiatives that have formulated AI principles. The second section synthesizes a list of AI principles for cities to use in the form of a framework.

3.1 PART 1: General overview of formerly issued AI principles documents

Multiple stakeholders, including private and public sectors, Non-Governmental Organizations (NGOs), associations, and academic institutions have published AI principles. More specifically, in the past five years, there has been a proliferation of AI principles documents providing guidance in concomitance with increased use of AI systems and solutions in cities.

Table 1 is a non-exhaustive compendium of erstwhile issued AI principles indicating their names and sources from different stakeholder types.

Table 1: Examples of formerly issued AI principles documents

AI Principles Name	Source
Recommendation on the Ethics of Artificial Intelligence	UNESCO
Asilomar AI Principles	Future of Life Institute
A Unified Framework of Five Principles for AI in Society	MIT
AI at Google: our principles	Google
Understanding artificial intelligence ethics and safety A guide for the responsible design and implementation of AI systems in the public sector	The Alan Turing Institute
AI Ethics Principles	Australian Government - Department of Industry, Science, Energy and Resources
Beijing AI Principles	Beijing Academy of Artificial Intelligence (BAAI)

AI Principles Name	Source
Ethics Guidelines for Trustworthy AI	European Commission – Independent High-Level Expert Group on Artificial Intelligence
G20 AI Principles	G20
Everyday Ethics for AI	IBM
Ethically Aligned Design A Vision for Prioritizing Human Well-being with Autonomous and Intelligent Systems	IEEE
Responsible AI Principles	Microsoft
Montreal Declaration for A Responsible Development of Artificial Intelligence	University of Montreal
Recommendation of the Council on Artificial Intelligence	OECD
AI Principles	Telefonica
Guiding Principles on Trusted Ai Ethics	Telia Company
Promoting the Use of Trustworthy Artificial Intelligence in the Federal Government	USA - Executive Order 13960 of The President
Principled Artificial Intelligence	Harvard University Berkman Klein Centre
Six Principles of AI	Tencent Institute
AI Industry Code of Conduct	AI Industry Alliance
Governance Principles for a New Generation of AI	Chinese National Governance Committee for AI
Social Principles of Human-Centric AI	Government of Japan; Cabinet Office; Council for Science, Technology and Innovation
Principles to Promote FEAT AI in the Financial Sector	Monetary Authority of Singapore
AI Principles and Ethics	Smart Dubai
For a Meaningful AI	Mission assigned by the French Prime Minister
Human Rights in the Age of AI	Access Now
Universal Guidelines for Artificial Intelligence	The Public Voice
Guidance on Integrated Urban Hydrometeorological, Climate and Environmental Systems	WMO
Blueprint for an AI Bill of Rights	White House Office of Science and Technology Policy
NIST AI Risk Management Framework	National Institute of Standards and Technology – U.S Department of Commerce

It is important to note that Table 1 includes examples of formerly issued AI principles documents, rather than aiming to be comprehensive. It is also important to note that there exists sector specific (e.g., health care, finance and justice) AI principles, which were mostly omitted from Table 1 to maintain a generic AI principles approach.

During the thematic group discussions, it was observed that there are many commonalities of AI principles in these documents. Several recurring principles emerged with varying degrees of presence in these documents.

3.2 PART 2: Guiding principles framework for AI in cities

Cities reside in a broader context in their national environments and partake in different local, regional, and global alliances and partnerships. Hence, their legal, economic, social, governance and environmental aspects differ (among others).

It is important to note that the set of principles listed in this document pertain to general city aspects and encompass potentially applicable common principles, which are not specific to a particular sector. Certain sectors may opt to develop their own sector specific and detailed principles pertaining to their own needs.

This section enumerates a list of principles that cities can adopt in their own contexts. It briefly discusses each principle and provides in some cases further explanation and implementation considerations to enhance their understanding.

The first principle can be presumed compulsory since compliance with applicable laws and regulations are inherently mandatory for AI systems.

3.2.1 Lawful

AI systems exist in a broader context and are subject to laws and regulations applicable to all the jurisdiction(s) which they are part of. Therefore, AI systems should identify all relevant and applicable laws and regulations and comply with them. These laws and regulations can be international, regional, national or local.

Note: Additionally, cities in their AI systems implementations are recommended to consider many key agendas that have been developed and agreed upon and are applicable to their jurisdictions. These may include the following: 2030 Agenda for Sustainable Development, the New Urban Agenda (NUA), the Paris Agreement on Climate Change, the Connect 2030 Agenda for Global Telecommunication/ICT Development (Resolution 200 (Rev. Dubai 2018)), the UN Secretary-General's Roadmap on Digital Cooperation, the Resolution on the right to privacy in the digital age, the Resolution on new and emerging digital technologies and human rights, regional EU Agendas (including Lisbon Strategy, the 10-year Digital Agenda for Europe, as well as the EU Digital Compass and the New Leipzig Charter, and so on).

3.2.2 Privacy preserving

Artificial intelligence, where a sufficiently large and reliable set of information is available for the purposes of use in a specific city, could offer a significant contribution to the understanding and rapid resolution of urban problems. However, any use of information sets must necessarily comply with existing privacy regulations and laws set at the state or supranational level. For example: (i) the United States has various federal and state laws that cover different aspects of data privacy, like health data, financial information or data collected from children; (ii) the European Union (EU) has regulated similar matters with Regulation (EU) 2016/679 of the European Parliament and of the Council on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.

Therefore, **it is necessary to affirm the essential principle that AI can only be used in full compliance with the data privacy regulatory framework in force at national or supranational level**.

AI systems operate in delicate contexts that may be exposed to, and even utilize, personal data, personal artefacts and personal property. In such contexts, it is very important for AI systems to duly uphold privacy.

Privacy is a fundamental human right and is incorporated in various international and national legislations (e.g., international human rights, national constitutions, data protection laws).

Hence, this principle allows cities to respect, protect and preserve privacy in developing, deploying and using AI systems.

Implementation Considerations: Cities should identify and comply with all the laws and regulations pertaining specifically to privacy (e.g., data protection laws, consumer protection laws, intellectual property rights laws). Many jurisdictions have enacted data protection legislations (e.g., General Data Protection Regulation in European Union), which may significantly influence and impact privacy related data management and processing.

Either existing laws and regulations and/or city stakeholder considerations may guide cities to implement privacy protection mechanisms in their AI systems. These privacy protection mechanisms include:

- Anonymization of data;
- Pseudonymization (or data masking) of data (e.g., encryption, shuffling, suppression);
- Data generalization (e.g., calculation of an aggregated value from sensitive data, using a value range);
- Creation of synthetic data;

- Obtaining consent from individuals (the information provided during the consent may differ in terms of providing details for its purpose, potential impacts, and the way data are processed);
- Providing means to control use of data;
- Redressing mechanisms (e.g., providing means to modify and delete data); and
- Incorporation of privacy during AI systems design rather than as an afterthought, i.e. "Privacy by Design".

3.2.3 Fair and Inclusive

AI systems make decisions or automate certain tasks on behalf of human beings. AI algorithms and the underlying data which AI systems use (e.g., for training purposes) may potentially include biases. These biases may stem either from AI systems design or in some cases from intrinsic or historical biases existing in organizations operating these AI systems. Figure 1 provides examples of various biases that contribute to harm within the data and AI application processes.

Figure 1: Examples of Biases in AI Applications (adapted from Source: NIST)

	Systemic Biases	Statistical Biases	Human Biases
DATASETS *Who is counted and who isn't?*	• Issues with latent variables • Underrepresentation of marginalized groups	• Sampling and selection bias • Using proxy variable due to ease of measurement • Automation bias	• Observational bias • Availability bias • Mc Namara Fallacy
PROCESS AND HUMAN FACTOR *What is important?*	• Automation of inequalities • Underrepresentation in determining utility function • Process that favor the majority/minority • Cultural bias in the objective function	• Likert Scale • Nonlinear vs linear • Ecological fallacy • Minimizing the L1 vs L2 norm • General difficulty in quantifying contextual phenomena	• Groupthink leads to narrow choices • Rashomon effect leads to subjective advocacy • Difficulty in quantifying objectives may lead to McNamara fallacy
TEST & EVALUATION, & VERIFICATION *How do we know what is right?*	• Reinforcement of inequalities • Predictive policing more negatively impacted • Widespread adoption of ridesharing/self-driving cars etc. may change policies that impact population based on use	• Lack of adequate cross-validation • Survivorship bias • Difficulty with fairness	• Confirmation bias • Automation bias

Additionally, these AI systems may not be inclusive in terms of the broad target potential group for which they are designed. It is important to ensure that no one is left behind in the target potential group, and that geographical, economic, social and digital equality is preserved by including all relevant people with different gender, nationality, ability, age, ethnic origin, and so on (including all marginalised and vulnerable groups).

Hence, this principle allows cities to purchase, deploy and use unbiased, non-discriminatory, and inclusive AI systems.

Implementation Considerations: Cities can adopt various mechanisms to boost the fairness and inclusiveness of their AI systems. These mechanisms include:

- Developing governance procedures around the procurement of third-party technologies incorporating AI technology;

- Identifying mechanisms to audit AI technology deployments and continuously monitor their deployment;
- Incorporation of unbiased diverse datasets;
- Ensuring equal and broad representation of the target population (or potential group) for which AI systems are designed;
- Implementation of accessible and user-friendly AI systems to realize the human rights of people with different abilities (mitigating barriers to access and usability where needed);
- Proactive assessment of existing non-AI biases, inequalities, and discriminatory practices to avoid their ratification into AI systems;
- Sharing the benefits of AI systems and empowering people equally;
- Ensuring diverse participation and engagement during AI systems design; and
- Designing and deploying AI systems by staff who are responsible and equipped with adequate skills in order to not introduce further biases.

3.2.4 Explainable and transparent

AI systems use sophisticated technologies and complex mathematical algorithms. The rationale behind the actual decisions and the results of AI systems are not easy to discern since they tend to be opaque in most cases due to their inherent design.

On the other hand, AI systems today make a large spectrum of decisions ranging from relatively less impactful ones to even life and death situations. Consequently, it is important to understand how AI systems reach their decisions and results in order to make sense of them, and more importantly, to enhance them.

Hence, this principle allows cities to procure, develop, deploy, and use explainable and transparent AI systems.

Implementation Considerations: Cities can adopt various mechanisms to help enhance the explainability and the transparency of their AI systems. These mechanisms include:

- Identifying appropriate use cases for using open-source algorithms (noting the potential risks, such as cybersecurity risks associated with open-source algorithms.);
- Conducting algorithm audits and AI systems' independent verification;
- Implement extensive testing frameworks whereby different data set modalities are used to check for potential bias. Creating public AI or algorithm registers (e.g., Amsterdam algorithm register, Helsinki AI register);
- Informing users when and how AI makes decisions for individuals or for important city matters to enhance transparency;

- Communicating AI systems' end-to-end development process transparently to boost trust;
- Assuring users of human autonomy over AI systems; and
- Creating awareness and better understanding of AI systems among their users and city stakeholders at large.

3.2.5 Accountable

Non-AI systems tend to have accountability mechanisms which enable human beings to question and remedy inaccurate results, and related adverse consequences and impacts. These provide assurances and trust in non-AI systems. It would be desirable to maintain accountability for AI systems as well.

Consequently, this principle allows cities to procure, develop, deploy and use accountable AI systems.

Implementation Considerations: Cities can adopt various mechanisms to help enhance the accountability of their AI systems. These mechanisms include:

- Implementation of appeal and redress processes;
- Verification of results from AI systems (e.g., independent auditing, replicability of results and decisions);
- Instituting human accountability across the entire AI system for results and decisions during AI systems' operations; and
- Instituting human accountability across the entire design and development processes of AI systems.

3.2.6 Safe and secure

AI systems should function as intended in a reliable and consistent manner; they should also circumvent any impairment and damage and avoid harm.

Hence, this principle allows cities to develop, deploy and use safe and secure AI systems.

Implementation Considerations: Cities can adopt various mechanisms to achieve safety and security in AI systems. These mechanisms include:

- Avoiding malfunctioning and harm through extensive testing and identification of vulnerabilities, or require testing by third party developers contracted with the city;
- Ensuring confidentiality, integrity and availability of AI systems;
- Safeguarding AI systems against cyberattacks and threats;

- Incorporation of security during AI systems design rather than as an afterthought, i.e. "Secure by Design";
- Auditing AI systems for safety and security on an ongoing basis;
- Implementing resilient AI systems (e.g., fall-back solutions, business continuity, disaster recovery mechanisms);
- Conducting risk assessments to ensure safety and security of AI systems;
- Designing response to either AI system component or even entire system failure and to determine corresponding performance levels; and
- Protect and respect personal data in line with privacy rules.

3.2.7 High performing and robust

AI systems in urban contexts are designed to achieve certain targeted performance objectives (e.g., accuracy, optimality, acceptable resource consumption) and they perform various functions to automate certain tasks (potentially reducing human involvement and intervention).

Therefore, it is very important to achieve a high level of performance which is acceptable for AI systems designers and users. These systems include algorithms and data (e.g., training data prior to actual usage, operational data while the system is in use).

AI systems operate under varying conditions. The conditions contemplated during AI systems design may differ from the actual conditions encountered during operation. Hence, it is very important for AI systems to uphold their acceptable performance levels not only during design, but also during actual operation (which may entail varying conditions). This is commonly referred to as performance robustness.

Hence, this principle allows cities to develop, deploy, and use high performing and robust AI systems.

Implementation Considerations: Cities can adopt various mechanisms to achieve high performance and robustness in AI systems. These mechanisms include:

- Defining performance objectives for AI systems including target and acceptable performance levels;
- Testing and evaluating AI systems' performance robustness with respect to parameter changes (perturbations) in algorithms (e.g., certain algorithms' performances may be highly sensitive to algorithm parameters);
- Testing and evaluating AI systems performance robustness with respect to changes (perturbations) in datasets (e.g., certain algorithms' performances may be highly sensitive to changes in datasets);

- Ensuring AI systems get trained, tested, and evaluated in lifelike environments which accurately represent actual operating conditions in real life (including realistic datasets and algorithms);
- Trading off optimality and robustness, where needed, to cautiously make decisions; and
- Develop governance or advisory committees to evaluate these trade-offs and assign accountability for their deployment.

3.2.8 Assessed for impact and sustainability

AI systems are designed to handle certain tasks and achieve a certain level of performance as discussed in the previous principle. However, it is important to take a broad perspective and assess the impact of AI systems in cities, i.e. to identify the future consequences of using these systems.

Impact assessment can be used as a forward-looking tool and considers the positive and adverse impacts during such an assessment. Impact assessment helps in balancing current and future sustainability with respect to AI systems. It is an invaluable tool for cities and their stakeholders by providing a well-informed and more holistic perspective of their AI systems.

Consequently, this principle allows cities to assess the impact of AI systems and to evaluate and ensure their sustainability. Recommendation ITU-T L.1480 "Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other sectors" give guidance on how to assess the positive effect of AI implementation.

Implementation Considerations: Cities can adopt various mechanisms to assess the impact of their AI systems and to evaluate their sustainability. These mechanisms include:

- Conducting well-defined impact assessments for AI systems (e.g., Recommendation ITU-T Y.4905 Smart sustainable city impact assessment and Recommendation ITU-T L.1410 Methodology for environmental life cycle assessments of information and communication technology goods, networks and services);
- Taking a broad social, economic, and environmental perspective during the impact assessment (e.g., social issues would include communal and individual aspects such as health and well-being, fears and aspirations, and cultural heritage; economic issues would include GDP, business output, employment and wages; environmental issues would include energy, GHG emissions, etc.);
- Defining the geographical scope (e.g., community, city, nation) and the time horizon clearly for the AI systems impact assessment (would help in quantitative and qualitative aspects);
- Determining the details of research and analyses for AI systems' impact assessment (e.g., stakeholders involved, interviews, surveys, economic and environmental models);
- Taking a holistic approach for AI systems' long-term sustainability from different perspectives and evaluating the costs, benefits and the risks; and

- Scoping the impact assessments (cities can opt to conduct impact assessments for certain potentially high impact AI systems rather than all of them, due to costs and efforts incurred during the impact assessment).

3.2.9 Enabling human autonomy

It has been observed in practice that AI systems have penetrated into various applications in cities and that this trend is projected to continue in the foreseeable future.

In this context, it is important to make sure the owners and operators of AI systems in cities preserve and maintain the human autonomy to support automated and human decision-making.

Humans should determine:

- how AI systems should be designed;
- what their capabilities and constraints are; and
- when and how humans would intervene in AI systems during their functioning.

Hence, this principle allows cities to enable complete human autonomy over AI systems.

Implementation Considerations: Cities can adopt various mechanisms to enable human autonomy over their AI systems. These mechanisms include:

- Setting AI systems design guidelines and specifications to include human oversight and "human in the loop" provisions;
- Establishing governance models that support deployment of AI systems;
- Determining the level of autonomy of AI systems (e.g., fully autonomous, semi-autonomous);
- Specifying clearly and explicitly when and how humans will intervene during AI systems' operations (e.g., pre-specified points during the tasks, in case pre-determined conditions occur, exceptions);
- Determining whether AI systems should be deployed or not based on sufficient testing and confidence; and
- Maintaining the right and the capability to switch off AI systems.

Data and algorithm aspects of AI systems: AI systems rely on algorithms operating on datasets. It is of the utmost importance to consider algorithms and data distinctly for each of the above principles. Compliance of one with respect to a principle does not necessarily warrant the compliance of the other. Hence, data and algorithms should be analysed separately and assessed for compliance with the principles that cities adopt.

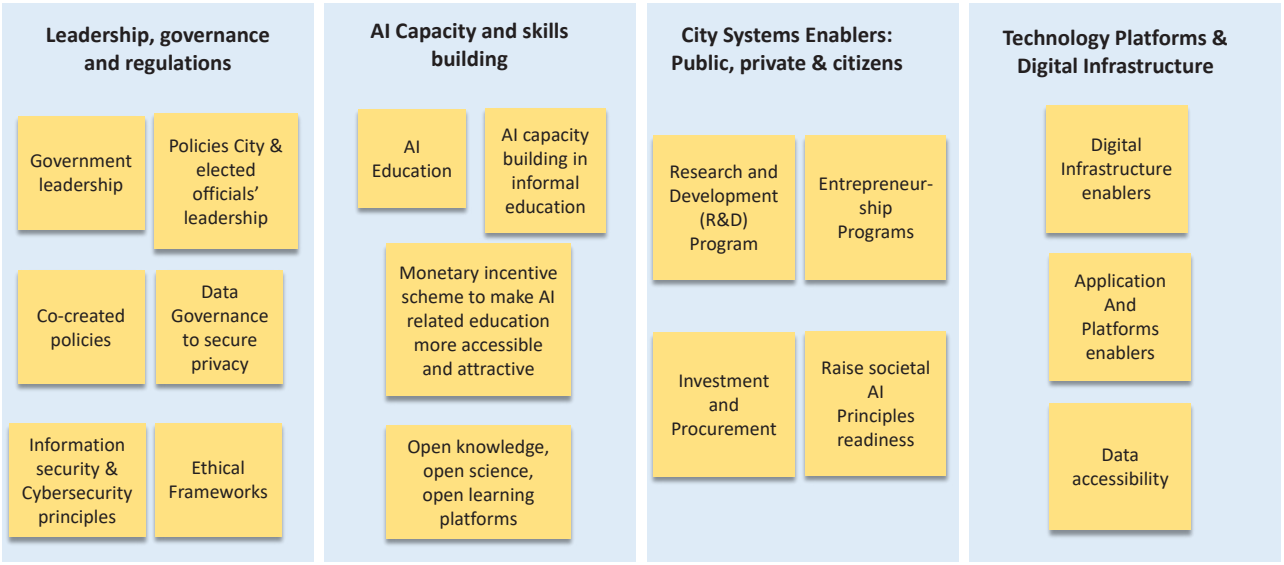
4 AI principles enablers

Enablers are complementary activities which support or accelerate the implementation of AI principles. This section establishes a framework of enablers through a bottom-up approach.

Four main categories of enablers have been designated which contain the list of enablers:

- Leadership, Governance, and Regulations;
- AI Capacity and Skills building;
- City Systems Enablers: Public, Private & Inhabitants; and
- Technology Platforms & Digital Infrastructure.

Figure 2: Enablers Framework for AI principals for Sustainable and Smart Cities



It is important to note that the set of enablers presented in this guide considers the differences between cities, regions, continents and different parts of the world. The list of enablers presented in this section is intended to be non-exhaustive, but is, nevertheless, a representative list that can be implemented in diverse cities, while considering differences that exist among cities. Cities can identify and select a set of viable enablers, not necessarily all, for their contexts during AI principles implementation, only if deemed beneficial.

[1] https://www.unece.org/housing/forumofmayors2020.html

[2] https://swedishtestbeds.com/en/about-swedish-testbeds/

4.1 Leadership, governance, and regulations

National and local governments' leadership and regulatory support can expedite and ease the AI principles implementation. Table 2 illustrates how national and local governments can play an enabling role through examples.

Table 2: Examples of leadership, governance, and regulatory enablers

Enabler	Enabler Examples
National Government Leadership	National leaders can educate and influence AI principles' target stakeholders through soft power steps (e.g., creating awareness programmes). It is also desirable to explain the AI principals to inhabitants and communities in a simple way, and to involve them in the selection of potential values and principles. Awareness programmes can be developed in diverse ways such as through think-tanks, policy dialogues, general debates and/or lectures. Mutual understanding of AI principles between government leaders and their stakeholders will warrant acceptance and confidence during the implementation. On the other hand, government leaders could also foster AI principles implementation through hard power by adjusting or creating policies, building AI-friendly platforms and infrastructure, and developing AI government leadership and skills, through • National strategies on Artificial Intelligence; • Network(s) of AI experts; • National and local committees for AI principles; • Funding mechanisms for AI-related activities; • Legal framework (e.g., regulatory and legal support for AI); • Training plans for relevant public sector staff on the field; • Incentives to promote AI entrepreneurships: fiscal/non-fiscal rewards; • Public-private partnerships on AI applications; and • International Partnerships on AI research, standardization, and shared experiences.
City & Elected Officials' Leadership	City & elected officials can develop the local AI ecosystem through: • Building AI awareness at a city level related to community concerns; • Developing procurement policies and requirements that incentivize ethical AI deployments; • Support the innovation of AI implementations for businesses in urban contexts; • Shared infrastructure and resources (e.g., innovation hubs, AI Valley); • City adapted policies to incentivize AI (e.g., AI procurement policies in the public sector, lower taxes for companies developing AI solutions, funds to support research and development); • Conducting AI trainings and implementation of AI toolboxes; and • Participation in national, regional, and international city associations and organizations for AI.

Enabler	Enabler Examples
Co-created Policies	National or local governments can develop R&D (research and development) and innovation policies on AI, fostering AI applications with positive impacts on inhabitants' daily lives, increasing public and private investment and promoting the development of trustworthy AI. AI policies can be co-created with city stakeholders to build public confidence and legitimacy in AI principles. The city stakeholders that may participate in policy co-creation include: • City officials; • Experts related to AI principles, technical AI aspects, human rights, data, etc.; • Scientists (social, humanities, data); • Target inhabitants and community groups, councils, associations, etc. • Private sector experts; and • NGOs.
Data Governance	A robust national or local data governance regulatory framework, potentially including data privacy and data protection, will assist and facilitate addressing data concerns in AI implementations. Cities can potentially capitalize on existing city and national data governance frameworks as well as cross-border ones (e.g., European Union's General Data Protection Regulation or GDPR, Cross-Border Privacy Rules or CBPR developed by the APEC - Asia-Pacific Economic Cooperation)
Information Security & Cybersecurity	Existing national or local information security and cybersecurity policies will help to address safety and security concerns in AI implementations. Cities can potentially undertake other security enhancement and incentivisation mechanisms such as: • A dedicated certification process for AI Secure applications; • Transparency of security aspects of AI principles implementation processes; and • An open collaboration platform for AI Security issues.

4.2 AI capacity building

AI applications in cities is a relatively new field. Moreover, AI principles are a novel topic requiring new skills and insights in the context of AI technology. Therefore, capacity building in AI principles is an important enabler for cities.

Capacity-building programmes can help establish new skills and knowledge for effective implementation of AI principles. Capacity-building programmes include formal and informal learning, preparation and conducting of training programmes, developing skills enhancement tools and related instruments (e.g., toolkits). They can improve inclusion and educate future talent in the city.

Formal training can help boost the relatively advanced skills of technical experts and informal education can help build trust and reinforce AI skills.

Table 3 illustrates some examples of capacity-building activities.

Table 3: Examples of capacity building enablers

Enabler	Enabler Examples
AI Education	• AI principles topics included in general education programmes of schools to teach about AI technologies and capabilities (available and affordable for students as part of their curricula); • Increased investments in higher education in the field of ICT/AI, and related educational research and development (R&D) activities; • Private sector-led training programmes in AI principles and other AI topics; and • Building AI principles toolkits, assessment tools, etc., and providing training on them.
AI capacity building in Informal education	• Workshops with local communities about AI capabilities in Public Sector for greater service efficiency and cost effectiveness; • Call for challenges and hackathons to create solutions with AI for a Smart and Sustainable city; and • Mentorships with experts from various fields. (social scientists, humanities' scientists, digital accessibility experts, human rights experts, interaction design experts, etc.)
Monetary incentive scheme to make AI related education more accessible and attractive	Public, private, and academic joint grants and partnerships for AI skills development, through: • AI related scholarships; • Free courses; • Competitive grants for doctoral candidates; and • AI courses and web-based training programmes - Massive Open Online Courses (MOOC). State level investment to open innovation and open science: • Joint funding programmes like grants, funds for AI-related curriculums at all education levels and in-service trainings; and • For city officials, benefit schemes for completing certifications and AI/ Sustainable Smart Cities upskilling designed into their work processes.

Enabler	Enabler Examples
Open knowledge, open science, open learning platforms	Join worldwide initiatives: • Open platforms providing AI capacity building; • Open knowledge and open science schemes Network (okfn.org); • Open platforms for sharing AI deployment experiences; and • AI policy initiatives (e.g., OECD AI Policy Observatory)[2].

4.3 City Systems Enablers: Public, private & inhabitants

Cities either already have or may plan to institute various other enablers that will directly or indirectly advocate AI principles, and, more generally, AI solutions. Innovation systems such as AI entrepreneurship support programmes and organizations, AI-related R&D in public and private sectors, and AI investment and procurement schemes may all advance the implementation of AI principles. Similarly, citywide engagement and participation of stakeholders will increase trust in AI systems and create awareness.

Table 4 illustrates some examples of various additional city enablers.

Table 4: Examples of city systems enablers

Enabler	Enabler Examples
Research and Development (R&D) Programmes	• AI R&D related policies and incentives (e.g., government tax incentives for private sector R&D, public sector R&D grants); • Funding resources for academia; • Providing access to data and key innovation resources; and • Innovation Programmes and challenges (city, local, national, and international).
Entrepreneurship Programmes	• General AI incubation programmes in cities for start-ups and entrepreneurs; • AI in smart cities incubators, innovation hubs and networks, promoted by governments, private institutions, and academia; and • Accelerator programmes in cities for AI.

[2] http://www.oecd.org/going-digital/ai/

Enabler	Enabler Examples
Investment and Procurement	• Local investments in AI applications for smart sustainable cities and in AI-friendly infrastructure; • Venture capital for AI; and • Public procurement contracts awarding based on AI innovation.
Raise societal AI principles readiness	**Citizen Engagement** • AI applications co-creation with inhabitants and local communities; and • AI communication campaigns and related events, storytelling, ads, etc. **AI application affordability** Government or telecommunications operators could make AI using devices affordable for inhabitants to use AI enabled applications, through subsidies, payment plans, free distribution etc. (e.g., provide senior inhabitants with a wrist sensor to monitor blood pressure/fever that would report this information to a central repository) **Inclusive AI apps: Gender equality and social, cultural & economic inclusion** AI should be discussed in advocacy communities and global events, to support inclusion of persons with different abilities, gender, etc., and to ensure AI applications do not exacerbate inequalities.

4.4 Technology Platforms & Digital Infrastructure

AI friendly infrastructures and platforms have the potential to contribute to a city's smartness and sustainability. Hence, city administrations can promote the development and deployment of AI in urban contexts while also implementing AI principles.

Table 5 illustrates some examples of city infrastructures and platforms to assist in AI applications, and, in turn, in implementing the AI principles.

Table 5: Examples of city infrastructure and platform enablers

Enabler	Enabler Examples
Digital Infrastructure enablers	• Available and affordable broadband connectivity (e.g., wireline connectivity such as cable, Digital Subscriber Line (xDSL), fibre, mobile and wireless connectivity such as 3G/4G/5G); • Secure Public, Private and Hybrid cloud to enable running AI applications and platforms (e.g., High performance computing for deep learning); and • IoT licenses for entrepreneurs, municipality services combined with sensors, and any other IoT devices to gather open data and build AI apps.

Enabler	Enabler Examples
Application and Platforms enablers	• Open source AI algorithms and frameworks; • Open source or commercial AI applications; • Trustworthy AI mechanisms such as: o Building city resilience through AI applications; o Certifications for trustworthy AI (there are already efforts underway in Europe and US to define the criteria for trusted and ethical AI certifications); and o Cybersecurity in AI through information security services providers.
Data accessibility	• Commercially available data platforms; and • Open data platforms – national and local level open data platforms.

5 Governance of guiding principles for AI in cities

Successful governance of AI principles entails three main roles:

- Regulatory
- Execution
- Compliance

For each of these three roles, cities can adopt different levels of control in their approaches; namely centralized, decentralized and hybrid.

Table 6 briefly explains various options available to cities for governing AI principles by adopting different levels of centralization.

Table 6: Governance Alternatives for Guiding Principles for AI in Cities

	Centralized	Decentralized	Hybrid
Regulation	A single city agency (entity) takes responsibility for formulating the "Guiding Principles for AI" which are applicable to other city agencies (entities) **Note**: This option empowers a single city agency to formulate the city level principles; however, it compromises by incorporating more specific principles at the sector level	Each city agency (entity) takes responsibility for formulating its own "Guiding Principles for AI" which are applicable to its own agency (entity) only **Note**: This option gives more flexibility to city agencies to formulate their own principles; however, it compromises by achieving a coherent single set of principles at the city level	A single city agency (entity) takes responsibility for formulating the "Guiding Principles for AI" which are applicable to a set of city agencies (entities); additionally, some agencies can formulate their own "Guiding Principles for AI" which are applicable to them only **Note**: This option gives more flexibility to a subset of city agencies to formulate their own set of principles; however, it compromises by achieving a coherent single set of principles at the city level

	Centralized	Decentralized	Hybrid
Execution	A single city agency (entity) takes responsibility for implementing the "Guiding Principles for AI" for all city agencies (entities) **Note**: This option empowers a single city agency to implement the Guiding principles for AI; however, it can pose difficulties in terms of understanding and implementing all city agencies' requirements and delivering them in a timely manner	Each city agency (entity) takes responsibility for implementing the "Guiding Principles for AI" its own agency (entity) **Note**: This option empowers all city agencies to implement the Guiding principles for AI; however, it can pose difficulties in terms of understanding and implementing principles at each and every city agency and finding the right talent in each and every city agency	A single city agency (entity) takes responsibility for implementing the "Guiding Principles for AI" for a set of city agencies (entities); additionally, some city agencies (entities) take responsibility for implementing the "Guiding Principles for Ai" applicable to their own agencies (entities) **Note**: This option empowers a single city agency as well as other city agencies (entities) to implement the Guiding principles for AI; however, it can compromise achieving a coherent single implementation approach at the city level
Compliance	A single city agency (entity) takes responsibility for assessing compliance with the "Guiding Principles for AI" which are applicable to city agencies (entities) **Note**: This option empowers a single city agency to assess compliance at the city level; however, it may pose difficulties in terms of conducting all city agencies' (entities') compliance in an efficient and effective manner	Each city agency (entity) takes responsibility for assessing compliance with the "Guiding Principles for AI" which are applicable to its own agency (entity) only **Note**: This option gives more flexibility to city agencies to assess their own compliance; however, it potentially compromises achieving a coherent single assessment approach at the city level	A single city agency (entity) takes responsibility for assessing compliance with the "Guiding Principles for AI" which are applicable to a set of city agencies (entities); additionally, some agencies can assess compliance with their own "Guiding Principles for AI" which are applicable to them only **Note**: This option gives more flexibility to a subset of city agencies to assess their own compliance with the set of principles; however, it compromises achieving a coherent single assessment approach at the city level

Each city, depending on its own context, particular constraints, and specific considerations, may determine its own governance approach for regulation, execution and compliance of the "Guiding Principles for AI".

Stakeholders, including public and private sectors, NGOs, civil society and very importantly the city inhabitants themselves, can work collectively as partners to establish good governance as an institutional mechanism. Creating a public-private-people partnership (PPPP) through a rich urban ecosystem is critical. Engaging and working with stakeholders through shared platforms to make the best use of cities' collective capital and to ensure inclusivity are important for success. City agency(ies) can engage a broad set of stakeholders during the governance of guiding principles for AI in cities.

6 Policy instrument alternatives for guiding principles for AI in cities

Cities have a set of policy instrument alternatives for formulating their "Guiding Principles for AI", as indicated below:

- Law
- Regulation
- Policy
- Guideline

Laws and regulations are rules promulgated by legally authorized bodies such as a government agency or an appropriating agency. Laws and regulations are enforced to their full authorities, and violations of both may incur penalties.

However, laws go through a legislation process before being enacted as laws; but regulations are created by an authorized agency (e.g., government agencies) and do not have to go through the legislation process. In some cases, regulations are formulated to implement a given law.

On the other hand, policy is a deliberate system of principles to guide decisions and achieve certain intended outcomes. Policy for guiding principles for AI can be adopted by an appropriate city governance body. In a broader form, the policy for guiding principles for AI is a plan of action adopted or pursued by a city agency. Policies can be enforced, and it is generally a legal requirement to follow them.

Last, but not least, are the guidelines, which, as the name implies, are issued with the expectation that the applicable city agencies will follow them; however, strictly speaking, they are neither required nor forced to follow them.

Each of the four can be considered as an alternative (or potentially viable) instrument (or tool) to help cities implement guiding principles for AI within their jurisdictions.

Note: Some cities can initially formulate their guiding principles for AI and issue them in a less stringent and enforceable manner; for example, as a guideline or as a policy. They can then convert them into regulations or laws as their maturity enhances over time. Naturally, the specific course of action taken by cities will vary depending on their contexts.

Some General Considerations for Policy Instrument Formulation: AI systems are becoming pervasive in many smart and sustainable cities and communities and concern several types of stakeholders. In this context, it might be beneficial to understand different stakeholders' views and perspectives during the formulation of guiding principles for AI in cities. Naturally, city agencies (entities), AI solutions providers from private sector, NGOs, and other civic organizations, academia, and last but not least civic participation and advice from the public, may facilitate in assessing various issues pertaining to stakeholders. Consequently, the city agency(ies) responsible for

developing guiding principles for AI may be better informed to decide on specific principles, as well as implementation considerations in their urban contexts. This framework document provides high-level guidance on options available to cities rather than prescribing a single unique approach.

The extent and level of stakeholders' engagement and participation, specific consultation method(s) exercised, decision schemes utilized (e.g., top-down by public sector, consensus among stakeholders, etc.) will differ from city to city during the actual policy instrument development process.

7 Guiding Principles for AI in Cities - Methodology

This section describes the four-step guiding principles for AI in cities framework methodology. The methodology depicted in this section is an action-oriented, pragmatic approach to implementing guiding principles for AI in cities, as opposed to implementing AI solutions per se.

The four steps are as follows:

I. Assess the Current Status of Guiding Principles for AI in the City (Baselining);

II. Determine Guiding Principles for AI in the City;

III. Catalyse Guiding Principles for AI Implementation in the City; and

IV. Assess Results.

The following briefly explains the four-step methodology.

I. Assess the current status of guiding principles for AI in the city (baselining)

This step involves setting the baseline scenario for guiding principles for AI that are currently being undertaken by the city and the potential enablers, governance and policy instrumentation tools, if any, that would support their implementation. Specifically, this step determines a city's current status (baseline) with respect to:

a the existing guiding principles;

b the existing enablers; and

c the existing governance and policy instruments that would support the implementation of guiding principles for AI.

Two representative tables incorporating the above three baselining items is shown in the Appendix. It can be used by a city to assess its current status, or baseline, with respect to its guiding principles for AI. The contents of the tables in the Appendix are fairly high-level and, in some cases, may require further clarification and description by the city to determine its current status.

II. Determine guiding principles for AI in the city

The city can determine its list of guiding principles for AI by deciding which principles will be important and applicable in its own context. The list of principles stated in this document can be used by cities as a reference; cities can also consider erstwhile issued principles by different jurisdictions globally.

Once the guiding principles are finalized by the various agencies (IT agencies, legal agencies, procurement agencies, etc.), it is also important for the city to determine the appropriate policy

instrument to utilize in ratifying them. Consequently, the city can issue its guiding principles as a law or regulation, or as a policy, or, last but not least, as a guideline.

Finally, the city determines its governance approach for the regulation and execution of, and compliance with, its guiding principles; i.e., the city decides which agency or agencies will be responsible for regulation, execution and compliance at the city level. Table 6 specifies governance alternatives for different levels of centralization. It can be used by the city as a high-level guidance in determining its specific governance approach.

III. Catalyse guiding principles for AI implementation in the city

The enablers discussed above can be utilized during this step to potentially enhance the effectiveness of guiding principles for AI during their implementation. The city can utilize an appropriate mix of the above-defined enablers to implement its own guiding principles for AI. In other words, combinations of enablers can be used during the implementation. Some non-exhaustive examples of potential enablers are given below to illustrate the concept:

- Capacity-building programmes can be used to overcome awareness gaps such as education and training programmes, university programmes, vocational programmes to enhance skills and competencies; existing published materials in this area such as reports, publications can be distributed and disseminated to the public, as well as to various related entities for AI principles;
- National and local-level AI strategies and related policy making in public and private sectors might be beneficial to boost the adoption of AI principles and AI in general;
- Financial incentives can be provided for AI implementations utilizing guiding principles for AI (e.g., tax breaks, reductions, exemptions, holidays, lower loan rates, impact investment);
- R&D programmes may be formulated and implemented in collaboration with academia in the city;
- Data governance frameworks, regulations and standards may be used as policy levers and tools to catalyse guiding principles for AI in the city;
- Awarding schemes may be formulated to incentivize and encourage the public and private sectors for successfully implementing guiding principles for AI; and
- Nurturing a rich innovation ecosystem and involving and incentivizing entrepreneurs and SMEs to adopt guiding principles for AI in their solutions and products would help accelerate AI principles implementation.

More broadly, the city can use the AI Principles Enablers indicated in this document as a reference and select the appropriate enablers depending on its own context.

IV. Assess results

This step involves either interim or final assessment of the results of implementing the guiding principles for AI in a city. Cities are strongly recommended to conduct assessments comparing actual outcomes retrospectively and objectively with respect to intended ones at the outset.

Similarly, the city can evaluate various enablers for their effectiveness during the implementation. Gaps can be identified, in order to be addressed and corrected in due course. Lessons learnt can be derived to understand positive and adverse consequences of the application of guiding principles for AI in the city. Positive aspects of successful applications may be potentially cross utilized among various AI solutions; for example, a successful policy in one AI solution may trigger the use of a similar policy approach in another. Such examples can also be extended to other enablers. On the other hand, identification of ineffective enablers would result in their potential relinquishment in due course.

Guiding principles inevitably shape and transform AI solutions. Therefore, it is important to assess their outcomes retrospectively. An ex-post impact assessment would be highly beneficial to understand various social, economic and environmental changes that occurred in the city and compare them with those intended prior to implementation.

The comparison of ex-ante and ex-post assessments will indicate deviations in terms of intended and actual outcomes. Such deviations may aid in planning more accurately in due course or fine-tuning guiding principles for AI.

8 Conclusion

Cities are either deploying or are planning to deploy AI systems to address their urban challenges. It is important to establish guiding principles for AI systems to ensure reliability and trust. Some of the conclusions from the framework and the real-life case studies in this deliverable are stated below:

- There is no "one size fits all" approach for guiding principles for AI in cities;
- It is important for cities to consider implementation issues in order to successfully ensure compliance with their AI principles;
- It would be beneficial for cities to segregate data and algorithms and individually consider both for principles compliance;
- Urban challenges and priorities, city administrations' smart sustainable city strategies, inhabitants' urban requirements can act as a viable demand for AI principles as part of a broader context for AI implementations;
- City administrators have a wide range of tools at their disposal to encourage and incentivize implementation of AI principles defined as enablers in this framework document (e.g., regulations, policies, awareness, start-up ecosystem);
- Exchange of knowledge at the local, regional, and international levels will help develop AI principles formulation and implementation and will also increase its sustainability in the long run;
- Cities have a wide spectrum of policy alternatives depending on how flexible or obliging they want to be in their AI principles implementation;
- Three governance options for the extent of centralization have been provided to cities in regulating, implementing, and assessing their compliance with respect to AI principles;
- Guiding principles for AI is a relatively novel topic and may benefit significantly from capacity-building and research and development (R&D) programmes; andF
- Cities can capitalize on AI principles by turning it into a viable economic sub-sector, while simultaneously utilizing them in addressing and solving their own urban challenges.

Appendix

This Appendix includes two simple tables that cities can utilize to assess their current status (baseline) with respect to guiding principles for AI.

Table A.1: Guiding Principles for AI, Governance and Policy Instrument Baseline Assessment

Guiding Principles for AI	Regulator Agency(ies)[3]	Execution Agency(ies)[4]	Compliance Agency(ies)[5]	Policy Instrument(s)[6]	Comments
Principle 1					
Principle 2					
.....					
Principle N					

Table A.2: Guiding Principles for AI Enablers Assessment through High-Level Questions

Assessment Element	Currently Exists	Brief Description	Comments
Are there national-level programmes for guiding principles for AI in the city?	☐		
Are there local/city-level programmes for guiding principles for AI in the city?	☐		
Is there an existing data governance framework in the city?	☐		
Are there existing information security and cybersecurity policies in the city?	☐		
Are there existing skills-boosting programmes for AI and guiding principles for AI in the city?	☐		
Are there incentive schemes to boost AI and guiding principles for AI in the city?	☐		

[3] Please list all city agency(ies) which have issued the guiding principle for AI.
[4] Please list all city agency(ies) which are required implement the guiding principle for AI.
[5] Please list all agency(ies) which conduct guiding principle for AI compliance assessment.
[6] Please list all policy instrument(s) issued by the city agency(ies)

Assessment Element	Currently Exists	Brief Description	Comments
Are there knowledge-sharing mechanisms and platforms for AI and guiding principles for AI in the city?	☐		
Are there existing research and development (R&D) programmes for AI and guiding principles for AI in the city?	☐		
Are there entrepreneurship programmes for AI and guiding principles for AI in the city?	☐		
Are there investment and procurement policies and incentives for AI and guiding principles for AI in the city?	☐		
Are there existing programmes for raising awareness for AI and guiding principles for AI in the city?	☐		
Are there existing PPP style partnerships in the city for AI and AI principles related implementation projects?	☐		
Are there existing digital infrastructures and platforms for AI and guiding principles for AI in the city?	☐		
Are there regulations and laws (e.g., laws, directives, legislations, standards) supporting or impeding AI and guiding principles for AI in the city?	☐		
Is there a vibrant and rich innovation ecosystem for AI and guiding principles for AI in the city?	☐		
Does the city collaborate with other local, regional, and international cities for AI and guiding principles for AI?	☐		

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