



BSI Standards Publication

Smart city use case collection and analysis — Smart urban planning for smart cities

Part 1: High-level analysis

National foreword

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SYSTEMS REFERENCE DELIVERABLE



**Smart city use case collection and analysis – Smart urban planning for smart cities –
Part 1: High-level analysis**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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SMART URBAN PLANNING FOR SMART CITIES –****Part 1: High-level analysis****FOREWORD**

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The text of this Systems Reference Deliverable is based on the following documents:

Draft	Report on voting
SyCSmartCities/286/DTS	SyCSmartCities/301/RVDTS

Full information on the voting for the approval of this systems reference document can be found in the report on voting indicated in the above table.

The language used for the development of this Systems Reference Deliverable is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC SRD 63320 series, published under the general title *Use case collection and analysis – Smart urban planning for smart cities*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- amended.

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INTRODUCTION

In recent years, research on the relationship between information and communication technology (ICT) and cities, focused on imagining the future of urban planning, has been one of the most interesting topics in the industry. Smart urban planning (SUP) for smart cities is a relatively new concept and has not received much attention around the world. The “smartness” of urban planning describes the intensive use of digital technologies to optimize the urban planning process. The concept of “smart city” has been implemented and developed all over the world. In order to construct a smart city successfully, knowing how to implement SUP for smart cities is essential, because it is the foundation of smart urban construction. However, at present, reaching a consensus on the overall architecture of standards of SUP for smart cities is still challenging. The direction and user requirements of standards development is not clear, which affects the development and application effectiveness of international standards of SUP for smart cities.

Aimed at addressing the above problems, a systems approach to collect and analyse SUP for smart cities use cases is put forward. The purpose of this document is to collect SUP for smart cities use cases globally, to sort out the current situation of SUP for smart cities both domestically and internationally, including methods, framework, ideas, and GAPS model, and to analyse the needs of SUP for smart cities work and its stakeholders.

Understanding the use cases makes it easier to describe SUP for smart cities clusters and highlight use cases' commonalities. All use cases that are selected have actual legitimacy. Planning requirements are extracted from the use cases, and recommendations are given for future standardization items related to SUP for smart cities. Collecting the use cases provides SUP for smart cities to validate confirm the SUP for smart cities reference model and reference architecture.

The target users for this document include the following stakeholders who have interest in SUP for smart cities:

- 1) smart city planners and service providers, who can learn about SUP for smart cities needs and how to implement the ideas;
- 2) government agencies and heads, who can use SUP for smart cities and implement in future works;
- 3) citizens who want to have a better understanding of SUP for smart cities;
- 4) SUP for smart cities operators who need to understand the requirements;
- 5) regulators who are responsible for developing and managing SUP for smart cities and related regulations.

SMART CITY USE CASE COLLECTION AND ANALYSIS – SMART URBAN PLANNING FOR SMART CITIES –

Part 1: High-level analysis

1 Scope

This part of IEC SRD 63320 explains the definition, development goals and theoretical models of smart urban planning use case collection and analyses. This document identifies the key application areas of smart urban planning and determines the stakeholders and the relationships among them in the guidance of use case template.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

smart urban planning

digital and intelligent urban planning system, in which advanced technologies are used in all aspects, from decision-making, compiling, reviewing to evaluation

3.1.2

use case

specification of a set of actions performed by a system, which yields an observable result that is, typically, of value for one or more actors or other stakeholders of the system

[SOURCE: ISO/IEC 19505-2:2012, 16.3.6]

3.1.3

stakeholder

interested party

individual, group or organization that has an interest in an organization or activity

Note 1 to entry: Usually a stakeholder can affect or is affected by the organization or the activity.

[SOURCE: IEC 62542:2013, 3.19, modified – "interested party" has been added as a preferred term and the corresponding note to entry deleted.]

3.1.4

domain

area of knowledge or activity characterized by a set of concepts and terminology understood by the practitioners in that area.

EXAMPLE Taken from Smart Grid/energy system area: Generation, transmission, distribution, customer.

Note 1 to entry: Major area of similar technologies and organizational background, for the energy system some domains are suggested in this document as examples throughout this document.

[SOURCE: ISO/IEC 19501:2005, Glossary]

3.1.5

functional requirement

requirement that describes what the system must do

Note 1 to entry: They are actions in response to events, or actions performed autonomously. They represent operations and features provided.

[SOURCE: IEC TR 62559-1:2019, 3.13]

3.1.6

non-functional requirement

requirement that describes what qualities the system must contain from an execution and performance perspective

Note 1 to entry: These are also known as “constraints”, “behaviour”, “criteria”, “performance targets”, etc. They set limits or controls on how well the system performs the functional requirements.

Note 2 to entry: Non-functional requirements include: reliability.

[SOURCE: IEC TR 62559-1:2019, 3.14]

3.2 Abbreviated terms

SUP	smart urban planning
ICT	information and communication technology
AI	artificial intelligence
CIM	Common Information Model
IoT	Internet of Things
LPWAN	low-power WAN
VR	virtual reality
SDG	Sustainable Development Goal
GIS	geographic information system

4 Contributing to Sustainable Development Goals

4.1 General

The United Nations published 17 Sustainable Development Goals (SDGs) with an aim to enhance world peace and prosperity, eradicate hunger and poverty, and protect people and the planet by 2030. It calls for innovation and broad collaboration between public and private society. The IEC SRD 63320 series mainly addresses Sustainable Development Goal 11 (Goal 11): sustainable cities and communities.

4.2 Application area of smart urban planning

Goal 11 aims to make cities inclusive, safe, resilient and sustainable. This goal includes 11 targets which are related to smart cities: 11.1 Safe and affordable housing; 11.2 Affordable, accessible and sustainable transport systems; 11.3 Inclusive and sustainable urbanization; 11.4 Protect and safeguard the world's cultural and natural heritage; 11.5 Reduce the adverse effects of natural disasters; 11.6 Reduce the environmental impact of cities; 11.7 Provide universal access to safe inclusive green and public spaces; 11.a Strong national and regional development planning; 11.b Implement policies for inclusion, resource efficiency and disaster risk reduction; 11.c Support least developed countries in sustainable and resilient buildings.

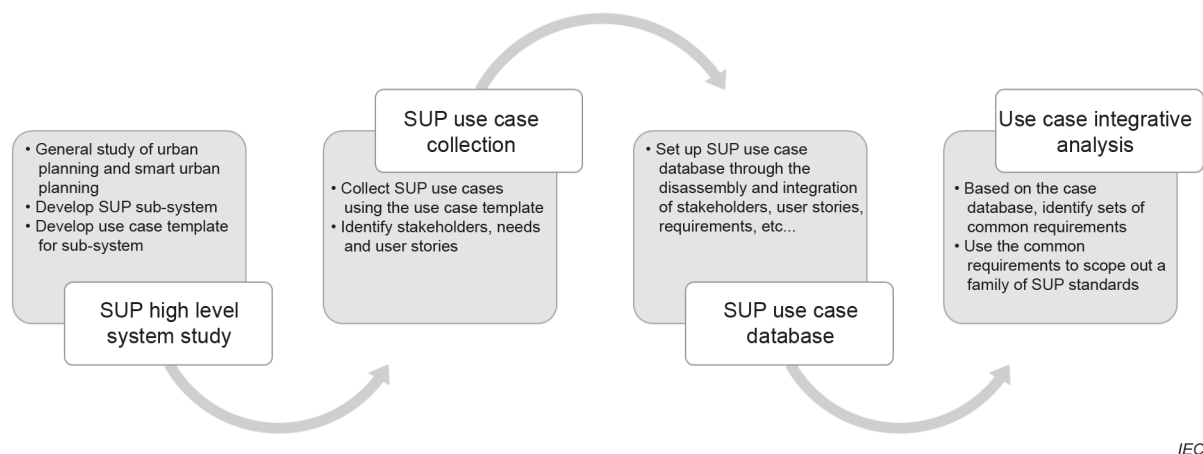
The SUP application areas studied in this document address the full list of targets in Goal 11 (Table 1). One application domain can address more than one target. For example, the application area of smart community addresses 11.1 Safe and affordable housing, 11.3 Inclusive and sustainable urbanization, and 11.7 Provide universal access to safe inclusive green and public space.

Table 1 – Mapping application areas of smart urban planning and SDGs

SDG	SDG target	Smart urban planning application areas
11.1 Safe and affordable housing	By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.	smart community action plan; smart land use planning; smart city security planning; smart economic planning
11.2 Affordable, accessible and sustainable transport systems	By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.	smart transportation planning
11.3 Inclusive and sustainable urbanization	By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.	smart community action plan; smart land use planning; smart economic planning
11.4 Protect and safeguard the world's cultural and natural heritage	Strengthen efforts to protect and safeguard the world's cultural and natural heritage.	smart heritage protection planning; protection planning of historical and cultural city; smart urban cultural planning
11.5 Reduce the adverse effects of natural disasters	By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.	smart water management planning; smart health-care planning
11.6 Reduce the environmental impact of cities	By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.	smart environmental protection planning
11.7 Provide universal access to safe inclusive green and public spaces	By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.	smart community action planning; smart ecology management planning; smart urban environmental protection planning
11.a Strong national and regional development planning	Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.	smart government services planning; smart urban master planning
11.b Implement policies for inclusion, resource efficiency and disaster risk reduction	By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels.	smart environmental monitoring
11.c Support least developed countries in sustainable and resilient buildings	Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials.	supervision of smart architecture

5 Approach for use case collection and analysis

The IEC SRD 63320 series adopts a top-down approach to generate and collect the use case of smart urban planning, as illustrated in Figure 1.



IEC

Figure 1 – Approach for use case collection and analysis

Firstly, a thorough study of smart urban planning is needed at the beginning of use case collection and analysis. The purposes of the work of SUP high-level system study include to identify sub-systems, to identify basic stakeholder needs, and to develop SUP a use case template for sub-system based on IEC TR 62559-1 and IEC 62559-2. The template of smart urban planning application area survey table is found in Annex A.

Secondly, generate and collect a list of use case about smart urban planning following the use case template. Develop a list of significant user stories based on the collected use case. In each corresponding area, one user story is generated for one specific stakeholder. Each user story follows the same template, which includes one stakeholder (as a specific type of user), a specific situation (when), a goal (I want to), and a reason (so that).

Thirdly, break down each element of the use case, including stakeholders, user stories, etc., and establish the use case database of smart urban planning.

Lastly, conduct an integrative analysis based on the use case database, and identify the standard gaps for smart urban planning and requirements for a family of smart urban planning standards.

This document focuses on the first and second steps of the work approach.

6 Use case stratification

6.1 General

IEC TR 62559-1 and IEC 62559-2 give a detailed definition and classification about business case, high-level use case and specialized use case. The IEC SRD 63320 series will consider the content and stratification of smart urban planning to correspond to three levels of use case.

6.2 Business case

A business case comes into being when something unites different actors (stakeholders) with their own business goals.

For smart urban planning, business cases can be identified according to the step of urban planning. There is a total of six business cases in smart urban planning, corresponding to the six steps of urban planning system, namely preparatory work, data collection and analysis, strategy formulation, plan review and approval, plan implementation, and monitoring and assessment.

6.3 High-level use case

High-level use case describes a general requirement, idea or concept independently from a specific technical realization like an architectural solution. High-level use cases can be derived from business cases through model transformation, in which business actors involved in business cases are transformed into logical actors that are interpreted as logical entities involved in a particular high-level use case.

For smart urban planning, the application area of smart urban planning is regarded as the high-level use case. The process of breaking down smart urban planning into different high-level use cases is a key part of high-level analysis.

6.4 Specialized use case of SUP

High-level use case usually describes an innovative, abstract function but the actual technical implementation is not dealt with. On this basis, specialized use cases can be developed and explain a tangible elaboration of the technical aspects.

7 High-level analysis of smart urban planning

7.1 General

Smart urban planning is the application of digital technology on the basis of urban planning. Therefore, model of smart urban planning is adjusted and transformed on the basis of model of urban planning.

7.2 Steps of urban planning

7.2.1 General

Urban planning is a systematic, formal, standardized work cyclic process. It includes pre-planning, planning and post-planning stages. These three stages are then further broken down into six steps, including preparatory work in the pre-planning stage, data collection and analysis, strategy formulation, and plan review and approval in the planning stage, implementation and monitoring and assessment in the post-planning stage.

- 1) Pre-planning stage. The first, and in some respects, the most important stage is ‘pre-planning,’ or preparing to plan. This stage diagnoses the planning area. Once local officials and the public understand the purpose, values and benefits of planning and agree on a process to prepare the plan, the following steps become much easier.
- 2) Planning stage. The second stage – ‘planning’ – consists of three major steps. These include data collection and analysis, strategy formulation, and plan review and approval. The planning stage in Figure 2 shows several positive feedback loops. This is meant to illustrate that planning does not always proceed in a linear fashion. At times, the planning department can need to revisit or reorder steps to respond to new data or unexpected reactions to a proposal. Some flexibility should be built into the process to accommodate these unknowns. Depending on how planners choose to organize the planning process, a given community may also have more or fewer steps than what is shown.
- 3) Post-planning stage. The third stage is ‘post-planning’, which consists of plan implementation, monitoring and post-implementation evaluation.

The urban planning system applies to all kinds of urban planning, including master planning, new and pre-existing land-use planning, urban revitalization, economic development planning, environmental planning, infrastructure planning, regulatory planning and so on.

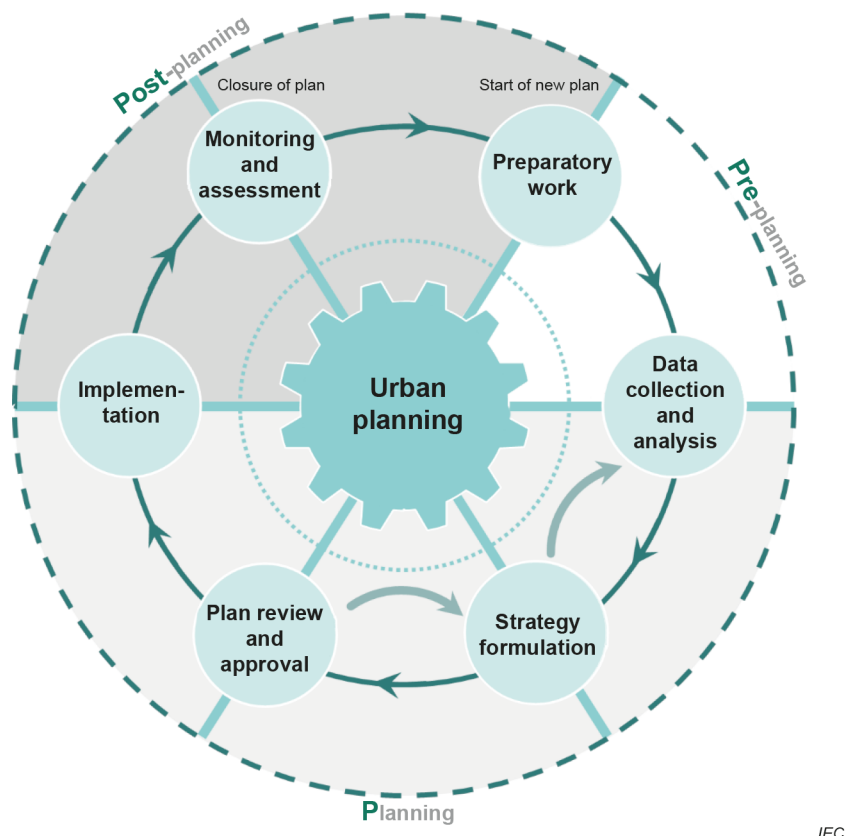


Figure 2 – The steps of urban planning

As shown in Figure 2, the steps of urban planning are a whole life cycle, from pre-planning stage to planning stage to post-planning stage, which includes six work steps. The conclusions of the last step, monitoring and assessment, usually become the basic material for a new urban planning project to start. The work achievements of each step will become the input for the next step through the arrow. In the strategy formulation step, it will return to the previous step to collect and analyse new data according to the requirements of new strategies. In the plan review and approval step, it will return to the previous step to modify the strategies if the plan review does not pass.

7.2.2 Step 1 – Preparatory work

The goals of preparatory work of urban planning are to identify the planning problems and objectives, available resources within the planning area, and stakeholders involved. The activities of this step are following.

- 1) Inventory existing urban planning, studies and tools.
- 2) Determine the planning purpose, capacity and readiness of the area.
- 3) Identify potential planning participants and stakeholders and agree with them on the urban planning purposes.

7.2.3 Step 2 – Data collection and analysis

Data collection uses various methods or technologies to collect city information needed by urban planning. The information collected is used for data analysis and planning compilation. Data analysis mines data value and planning suggestions from various items of urban information with the help of information analysis tools and technologies. The activities of this step are the following.

- 1) Urban information collection, storage and quality check.
- 2) Urban data analysis and interpretation.

7.2.4 Step 3 – Strategy formulation

Based on the issues reflected in data analysis and public opinion, and the development vision shared by relevant stakeholders, identify the potential planning strategies within the planning area from multiple aspects. Furthermore, this step also shall describe elements clearly involved during strategies implementation, including timeline, participants, investment fund, etc., to support the implementation of strategies. The activities of this step are the following.

- 1) Identify potential plan implementation strategies to satisfy goals and objectives.
- 2) Evaluate impacts of alternative strategies and select preferred options.
- 3) Recommend specific plan implementation policies, programmes, actions and tools.
- 4) Describe timeline and parties responsible for plan implementation.

7.2.5 Step 4 – Plan review and approval

Plan review and approval is the qualitative or quantitative review of planning results by planning decision-making departments of third-party institutions to make planning results in line with relevant policy requirements and demands of all participants. The activities of this step are the following.

- 1) Review the urban planning results to meet the requirements of laws, policies and published plans.
- 2) Present the plan for public and officials to review.
- 3) Make changes to the plan to resolve inconsistencies or address issues of concern to local officials and the public.
- 4) Take formal action to approve and publish the urban planning.

7.2.6 Step 5 – Plan implementation

Implementation supervises whether the implementation meets the planning requirements in the process of planning implementation. The activities of this step are the following.

- 1) Adopt a specific course of action to implement the plan.
- 2) Supervise the implementation of the project to meet the targets or achievements of the planning.

7.2.7 Step 6 – Monitoring and assessment

Monitoring and assessment evaluates the results of the planning implementation after the completion of implementation. It compares the gap between planning goals and actual situation. The conclusions of planning evaluation will provide a basis for new planning. The activities of this step are following.

- 1) Monitor progress towards achieving stated goals, objectives and indicators.
- 2) Review and revise plan according to schedule stated in the plan or in response to changing community needs.

7.3 Transformation of smart urban planning

Based on the steps of urban planning, the model of smart urban planning shall further interpret the planning process, activities and specific work with the help of digital and intelligent technologies.

The IEC 63320 series builds an innovative and sustainable model to drive the adoption of smart urban planning. It provides guidance for the working sequence of six critical steps of smart urban planning from preparatory work to monitoring and assessment, see Figure 3. Each step contains a number of planning activities as smart urban planning solutions supported by specific technologies, including big data, CIM, IoT, GIS, cloud, AI and so on. Specialized use case analysis shall follow such a systems model, building on the foundation of specialized use case collection.

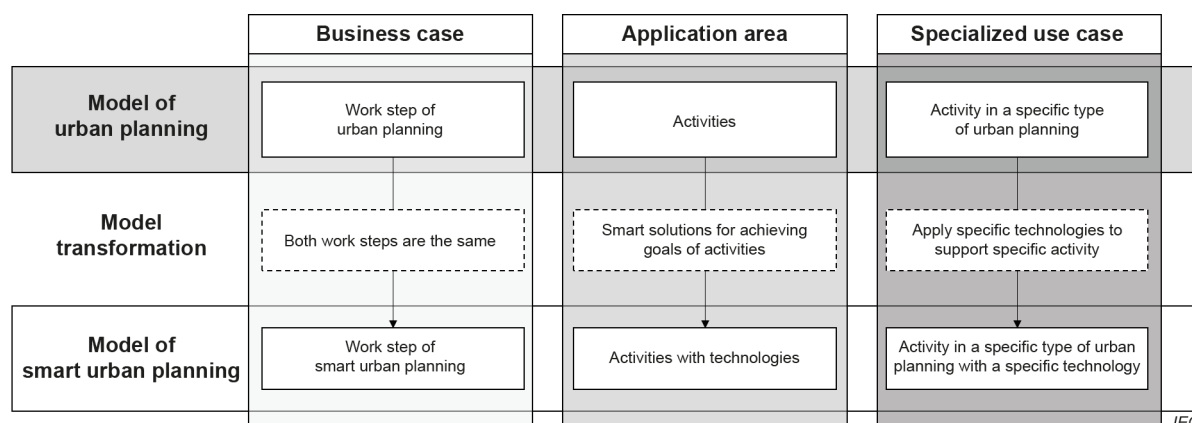


Figure 3 – The transformation of smart urban planning

8 Analysis conclusions of smart urban planning

8.1 General

Smart urban planning refers to a digital and intelligent urban planning system, in which advanced technologies are used in all aspects, from pre-planning phase to planning phase to post-planning phase. Urban planning is a complex system, involving a variety of urban planning types and complex workflow. Therefore, there are many options for digital and intelligent technologies to enhance the efficiency and effectiveness of urban planning.

8.2 Model of smart urban planning

8.2.1 General

The description of the SUP for smart cities architecture model is as follows.

Smart urban planning refers to optimizing the workflow and improving the accuracy and effectiveness of smart urban planning based on use of AI, big data, CIM, IoT, GIS, cloud and other technologies in six smart urban planning steps (business use cases), see Figure 4. Smart urban planning can help smart city planners, public sectors, regulators and others to formulate more scientific development strategies in various fields of smart cities, such as ICT infrastructure, smart transportation, smart municipality, smart community and other fields. It can help cities achieve sustainable development goals.

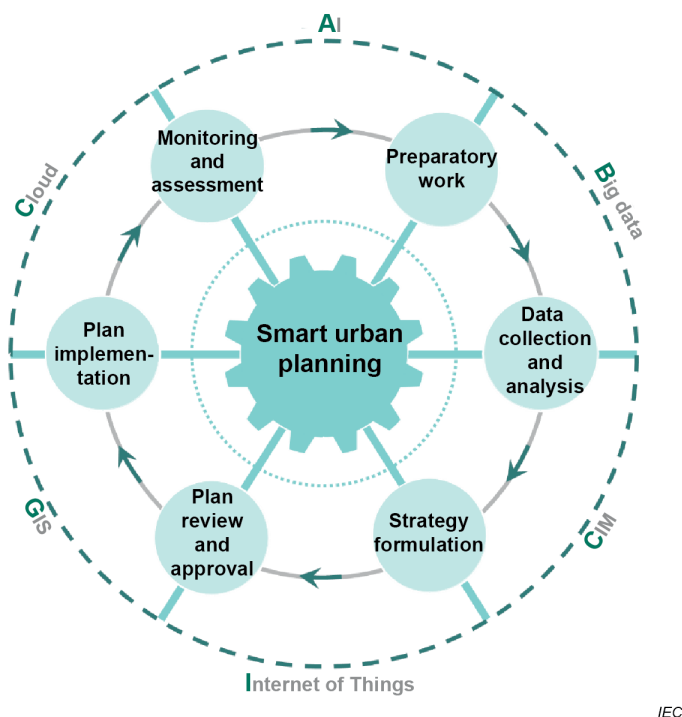


Figure 4 – The model of smart urban planning

8.2.2 Preparatory work

Preparatory work relies on the smart platform to assist planners and government agencies to organize planning tools, and try to gain recognition from more stakeholders. The technologies involved include database technology, knowledge graph technology, interactive technology and other intelligent technologies or technology packages.

The business use case of preparatory work includes two application areas: planning tool inventory and stakeholder identification, see Figure 5. The former is the most fundamental application area in the business use case of preparatory work, which aims to integrate all urban planning, studies and tools. The latter is an ensuing application area. With the support of inventory planning tools, it is easier to identify any potential stakeholders so as to set appropriate planning goals and objectives.

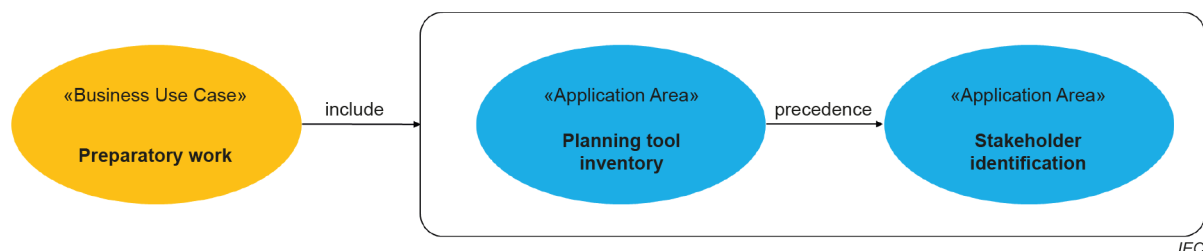


Figure 5 – General composition of preparatory work

8.2.3 Data collection and analysis

Data collection and analysis uses various methods or technologies to collect city information needed by urban planning, and to mine data value and planning suggestions from various items of urban information with the help of information analysis tools and technologies. The technologies involved include IoT, AI, GIS, CIM, big data, sensing technology, transmission technology and other intelligent technologies or technology packages.

The business use case of data collection and analysis includes two application areas: urban information collection and urban data analysis and interpretation, see Figure 6. These two application areas collect and then analyse city information in the preliminary process of smart urban planning.

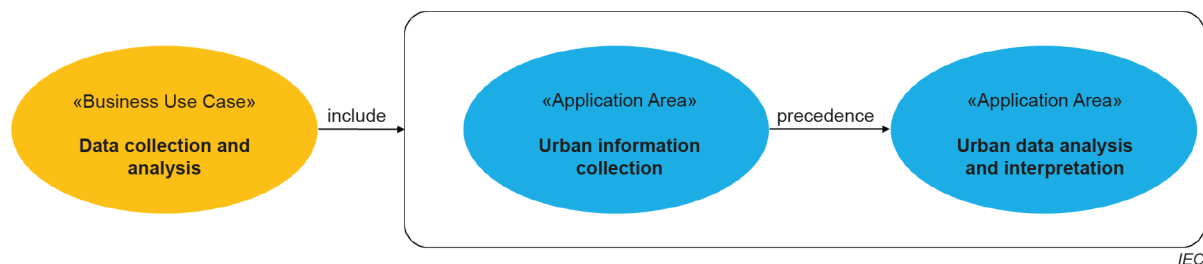


Figure 6 – General composition of data collection and analysis

8.2.4 Strategy formulation

Strategy formulation assists to improve the efficiency and quality of planning, or realize automatic planning with the help of technologies. The technologies involved include urban simulation, visual augmented design and other intelligent technologies or technology packages.

The business use case of strategy formulation includes three application areas: parametric planning, evaluate strategies and identify potential strategies, see Figure 7. The first application area is the most basic use case in the business use case of strategy formulation, which realizes digital strategy generation. Then the planning strategies are automatically assessed in the second application area. Ultimately the most reasonable strategy is identified with the support of previous parameterized planning schemes and evaluation results.

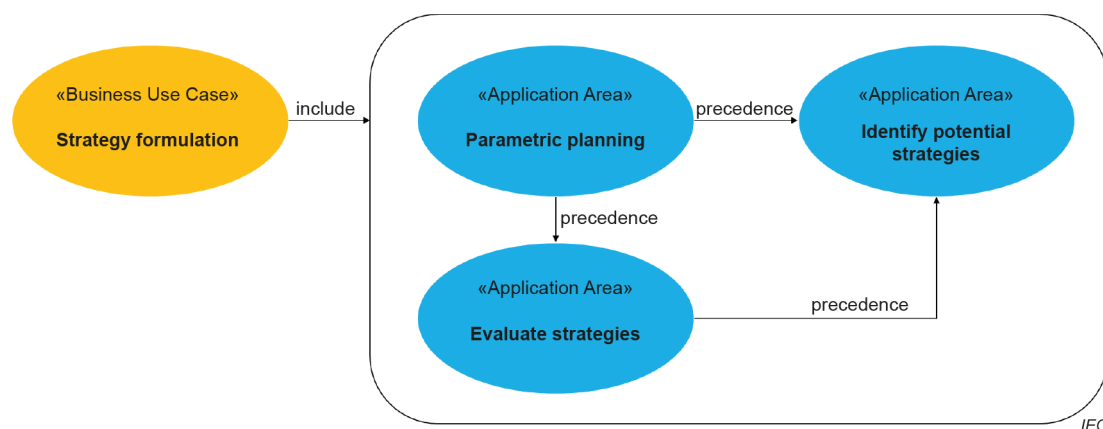


Figure 7 – General composition of strategy formulation

8.2.5 Plan review and approval

Plan review and approval is the qualitative or quantitative review of planning results by planning decision-making departments of third-party institutions to make planning results in line with relevant policy requirements. The technologies involved include spatial topology analysis, city information model and other intelligent technologies or technology packages.

The business use case of plan review and approval includes two application areas: present for review and approve and publish, see Figure 8. The former is the main application area in the business use case of plan review and approval, which aims to review projects for compliance. The latter is a subsequent application area, in which the planning is approved for construction and publicized if it meets the requirements.

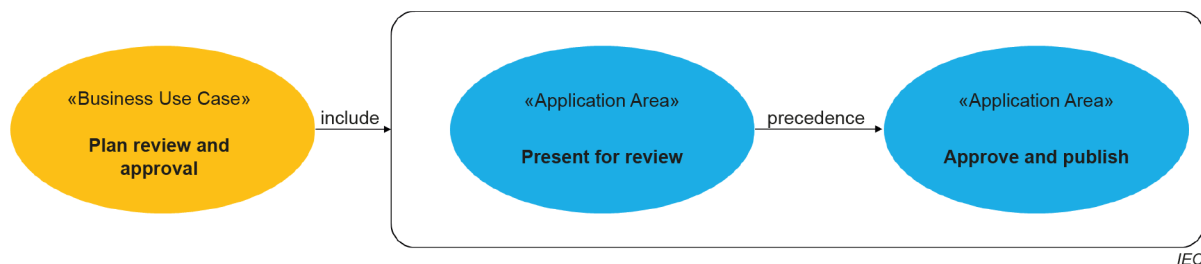


Figure 8 – General composition of plan review and approval

8.2.6 Plan implementation

Plan implementation supervises the implementation of planning requirements in the process of planning implementation based on the implementation data integration and intelligent analytics. The technologies involved include IoT, planning monitoring platform and other intelligent technologies or technology packages.

The business use case of plan implementation includes two application areas: planning conditions formulation and supervise implementation, see Figure 9. Planning conditions formulation is an important basis application area, which aims to control planning conditions to meet the requirements for the following implementation supervision.

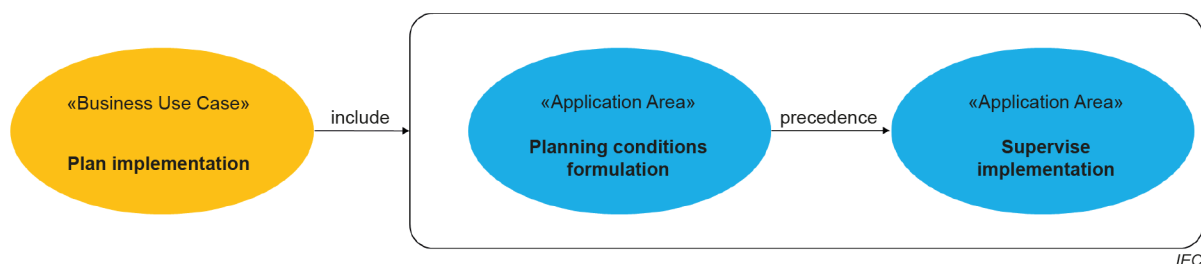


Figure 9 – General composition of plan implementation

8.2.7 Monitoring and assessment

Monitoring and assessment monitors and collect the city running data in real time, and carry on the systematic assessment for city public sectors. The technologies for planning evaluation involve urban examination platform, smart city operation centre and other intelligent technologies or technology packages.

The business use case of monitoring and assessment includes three application areas: dynamic monitoring, implementation assessment and public engagement, see Figure 10. The first application area a is fundamental scenario in the business use case of monitoring and assessment to grasp real-time urban building environment information. Then the implementation situation is automatically assessed in the second application area. In the third application area, public engagement promotes the people-oriented urban monitoring and assessment.

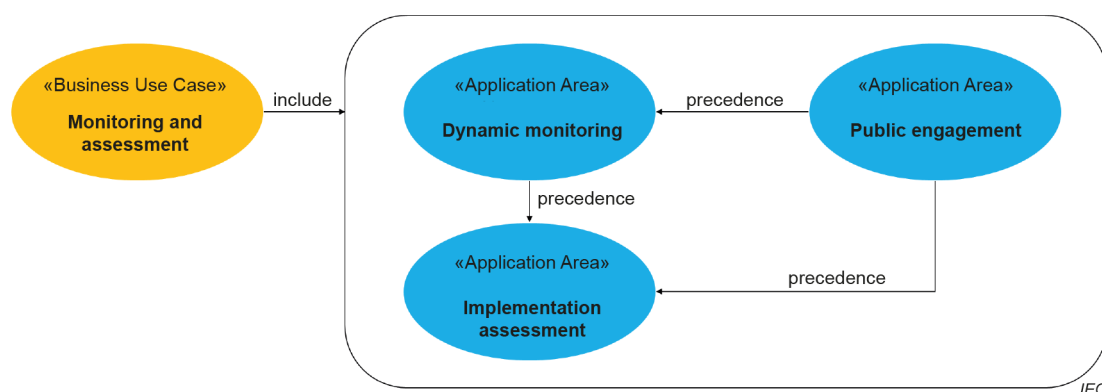


Figure 10 – General composition of monitoring and assessment

8.3 Characteristics of smart urban planning

8.3.1 Large numbers of heterogeneous urban data

A city will generate massive amounts of data during its operation, and its data sources can include traffic data, mobile data, municipal facility sensor data, economy data, etc. These massive amounts of data can effectively support the compilation of SUP for smart cities and become an important feature that distinguishes it from traditional planning. In the research of SUP for smart cities, people are able to grasp the dynamic changes of urban space and economy more intuitively and accurately by mining large data sample, real-time dynamic and micro-detailed urban planning data.

8.3.2 Analysis model based on technology

Different from traditional urban planning, which relies on empirical judgment and qualitative analysis, SUP for smart cities is based on big data and artificial intelligence (AI), which can accurately measure urban status, simulate and predict urban trends and automatically generate reference approaches through machine learning, urban quantitative analysis models and operational mechanisms. This will efficiently assist urban planners to make decisions, and greatly improve the accuracy and scientificity of SUP for smart cities research.

8.3.3 Information platform of smart urban planning for smart cities

In the SUP for smart cities, the ability to locate, transmit and share information will be rapidly improved. SUP for smart cities can accurately locate the interest groups affected by the plan through data analysis, and build information platform and discussion platform to reduce information threshold and let the public access the information and data more easily.

8.4 Technologies involved in smart urban planning

8.4.1 General

Technology has already been proven to assist in the urban planning process. Through technology, urban planning teams can increase their productivity and help citizens to get more involved in the urban design process. Some of those technologies are described in 8.4.2 to 8.4.8.

8.4.2 Cloud technology

It is a kind of data technology that collects, calculates, stores and manages massive data in a unified and standardized manner, including data collection, synchronization, data development, data quality management, data standards, data modelling and development, data security management, operation and maintenance management and other functions, so as to achieve efficient integration, unified management, sharing and exchange of city-wide data. With cloud technology, urban planners can create a database to receive details of certain urban areas. Moreover, cloud technology can help in planning larger infrastructure projects.

8.4.3 IoT technology

This technology is built based on the concept that all the desired devices can be connected inside a specific network for sharing data and information without any manual intervention. The devices used for this can be segregated conditional to their capability to send, receive and gather data in the given network. IoT is conspicuous due to its salient properties: it is secure in nature, can be used on smart devices, can connect to any type of network, aids faster connectivity, etc. Many of the basic IoT tools are already in use in an urban context. Those include smart streetlights that switch off automatically and save energy. Urban planners can build on those solutions and develop concepts that enhance the urban infrastructure.

8.4.4 AI-enabled review technology

This method is used in the planning review process. According to the purpose and requirements of the review, an automatic review system is developed to support issuing review reports, and assist the inspectors to complete format inspection, rigid index review. Standardized and objective machine review results are used to assist human review to form the final review conclusion, which serves as an important basis for project review (administrative review) and approval.

8.4.5 3D modelling technology

It applies the computer graphic technology, 3S technology – which comprises remote sensing (RS), global positioning system (GPS), and geographic information system (GIS) technology – and integrates urban two-dimensional vector data, digital image data, elevation model data, the new products of surveying and mapping data and other 3D model data. It aims to build different precision city 3D scenarios such as urban topography and landform, built environment, etc.

8.4.6 Spatial analysis technology

It refers to common spatial analysis tools, such as view analysis, sunshine analysis, thermal analysis and other spatial calculation models, which are used to analyse complex urban scenes. The basic spatial measurement and analysis functions such as distance measurement, height measurement and area measurement. The analysis results can be visually displayed with an urban 3D model.

8.4.7 Urban knowledge graph technology

It collects and processes data automatically, reduces the dimension of data into knowledge elements, and then constructs the knowledge system about the city. At the same time, the data of different urban planning knowledge fields are connected in series and parallel with the software to build a semantic network in the context of urban planning, so that it has the ability to explore, analyse and answer planning questions. In addition, the urban knowledge graph also supports advanced scenario planning functions, allowing planners to study and compare the "twin worlds" generated under different planning proposals, so as to optimize the planning scheme.

8.4.8 Virtual reality technology

Virtual reality is also helpful in simulating scenarios to model urban environments in 3D. Through the use of advanced visualization techniques, urban planners can visualize different urban areas. In this way, potential environmental impacts can be projected. This leads to better understanding of the content of planning and design in a dynamic interactive way, and improves the visualization ability of the planning scheme.

8.5 Overview of application areas collected

To arrange the business cases and high-level use cases in coherent order, an application area collection list can be derived, see Table 2. As the step of smart urban planning, each business use case contains several high-level use cases corresponding to the solutions to implement this step and forward to the next step.

Table 2 – The list of smart urban planning application areas

Steps of urban planning (business use case)	Application area
Step 1 – Preparatory work	B.1.1 Planning tool inventory
	B.1.2 Stakeholder identification
Step 2 – Data collection and analysis	B.2.1 Urban information collection
	B.2.2 Urban data analysis and interpretation
Step 3 – Strategy formulation	B.3.1 Parametric planning
	B.3.2 Strategy analysis and comparison
Step 4 – Plan review and approval	B.4.1 Present for review.
	B.4.2 Approve and publish
Step 5 – Plan implementation	B.5.1 Planning conditions formulation
	B.5.2 Supervise implementation
Step 6 – Monitoring and assessment	B.6.1 Dynamic monitoring

The detailed information collected for each smart urban planning application area is shown in Annex B.

Annex A
(normative)

Template of smart urban planning application area survey

SUP application area		
1 Basics	1.1 Name	
	1.2 Domain	Which step it belongs to?
	1.3 Author	Name of the organization: Address:
	1.4 Contact	Name: Email:
	1.5 Update Time	
2 Narrative	Short description of the background information, goal/objective and scope of the application.	
3 Objectives	To describe the aims or goals of the application area (mainly focus on the what the technology used in use case can solve or address)	
4 Background	4.1 Current Practices	To describe the best existing exercises or operations in the specific application area without technology of smart urban planning.
	4.2 Potential Technology	Briefly enumerate and describe potential technologies that can be used to enhance the current situation.
	4.3 Gaps	To indicate the differences, especially undesirable ones, between objectives and the current practices.

SUP application area		
5 Ecosystem		A person or group of people with an interest or concern in the application of smart urban planning, including name of stakeholders, role and responsibilities. When describing stakeholders for the specific application area of smart urban planning, the following roles are used: • <i>Primary beneficiary: stakeholders which benefit directly from the solution.</i> • <i>Secondary beneficiary: stakeholders which benefit indirectly from the solution.</i> • <i>Tertiary beneficiary: stakeholders which benefit indirectly from the solution at one further step removed.</i> • <i>Owner: stakeholders which own/manage the solution.</i> • <i>Designer: stakeholders which can participate in designing the solution.</i> • <i>Builder: stakeholders which can participate in building the solution.</i> • <i>Maintainer: stakeholders which can participate in maintaining the solution.</i> • <i>User: stakeholders which use the solution to help meet their needs.</i> <i>There may be other roles, for instance, financier, regulator, etc. Some stakeholders will have several stakeholder roles, dependent on the application scenario being considered.</i>
	5.1 Stakeholders	
	5.2 Relationships between the stakeholders	To describe the connections among two or more stakeholders in the process of applying technology. [draw a diagram to show relationships] (Simply, to describe the workflow in the application area using technology)

SUP application area												
	To describe the rational actions and their relevant information (name of action, objectives, description of activity and stakeholder) for the new practice in the specific application area. [list table] (the action could be regarded as the relationship line in workflow above) <table><tr><th>Name of action</th><th>Scope</th><th>Description</th><th>Actors involved</th></tr><tr><td>Extract data and do exploratory analysis</td><td>Extract data from databases that meet the purpose of the analysis and do some preliminary exploratory statistical analysis.</td><td>Data technicians are responsible for helping the planner or researcher to extract and sort data. With the extracted data, Data technicians should help the planner or researcher to do exploratory statistical data analysis to find problems or potential patterns ...</td><td>Planner/Researcher, Data Technician, Database</td></tr></table>				Name of action	Scope	Description	Actors involved	Extract data and do exploratory analysis	Extract data from databases that meet the purpose of the analysis and do some preliminary exploratory statistical analysis.	Data technicians are responsible for helping the planner or researcher to extract and sort data. With the extracted data, Data technicians should help the planner or researcher to do exploratory statistical data analysis to find problems or potential patterns ...	Planner/Researcher, Data Technician, Database
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6 Scenarios												
7 Requirements	To summarize the requirements in the process of applying the technology of smart urban planning, including the function, user, data, laws and regulation, standards, life cycle consideration and others.											
8 General remarks if any	Any key issue not mentioned above. For instance, listing any important existing standards that are widely used.											
9 Special use case if any												

Annex B (normative)

Description of smart urban planning application area

B.1 Preparatory work

B.1.1 Planning tool inventory

SUP application area		
1 Basics	1.1 Name	Planning tools inventory
	1.2 Domain	Preparatory work
2 Narrative This application area is based on is a multi-platform geospatial urban planning analytics system integrating data from various sources. It enables advanced spatial visualization and analytics for planners to easily access and analyse various land-use planning information that promotes the centralization of urban information, analysis methods, communication channels, information publication and other tools needed for urban planning. The collaboration platform is the key to construction of smart city and the basic support for the pre-process of urban planning. It can realize the integration and sharing of various information services including government data, industry data or private sources, provide dedicated analysis tools needed for planning strategies, and enable urban planning publicity, enquiry, information release and information feedback from the public. With quick access to such information, planners are better equipped to anticipate changes and coordinate better with relevant agencies to facilitate integrated planning.		

3 Objectives	a) Realize centralized storage, streamlined management, digitalized display of spatial data, department data urban sensing data and so on, and provide convenient data query and download function for users. b) Converge technologies such as integration of spatial analysis and modelling tools to effectively take advantage and mine value of vast urban data. c) Provide information publication and communication channels to release urban information or enquiry functions in the form of services, and promote the linkage of information, organization and work content within various government departments, as well as among other stakeholders.
4 Background	4.1 Current Practices Most urban planners and researchers usually search for and download urban information, especially geographic data, in map platforms, and public information in the government portals, or go to the planning department for non-public paper materials enquiry. Then they process these data through different technologies such as GIS and modelling software.
	4.2 Potential Technology Cloud technology. With cloud technology, urban planners can create a database to receive details of certain urban areas. Moreover, cloud technology can help in planning larger infrastructure projects. Analysis technology. It refers to WebGIS, spatial analysis tools and other technical algorithm carriers that provide services concerning spatial analysis on the website platform. Interactive technology. It provides a common website or mobile application to publish urban information and enable information query for all citizens and technicians.
	4.3 Gaps a) Difficult to obtain needed urban data in an effective way among different systems, different applications, and different technology platforms since the planning department is caught between "information isolated islands" where it is hard for information to flow fully. b) Difficult to ensure the reliability and feasibility of the planning decision-making based on experience. c) Difficult to motivate the public engagement in the process of urban planning because of the limited awareness and channels of public participation.