Defining the Requirements for 3D Visualization Standards in City Information Modelling

Michael Mulquin & Dr Chunlan Guo
IEC SyC Smart Cities

IEC
International
Electrotechnical
Commission

International Electrotechnical Commission

The IEC (International Electrotechnical Commission) is the world's leading organization for the preparation and publication of International Standards for all electrical, electronic and related technologies.

It is ISO's older sister, and we follow almost identical processes

Along with ITU, is one of the three WTO recognised International Standards Organisations

Why are we interested in City Information Modelling???!!!

Developing standards for complex systems requires a systems approach

- **System**: *a group of interacting, interrelated, or interdependent elements forming a purposeful whole of a complexity that requires specific structures and work methods in order to support applications and services relevant to stakeholders.*

- **Systems Approach**: *a holistic, iterative, discovery process that helps first defining the right problem in complex situations and then in finding elegant, well-designed and working solutions. It incorporates not only engineering, but also logical human and social aspects.*

Looking at it another way

No one is interested in Web 3D!

- Many people are interested in games, AR or VR, Digital Twins ….
- They are only interested Web 3D in as far as it can help them in their work
- This is why, before we develop Web 3D technologies and standards, we need to understand the requirements of the wider systems to which our technologies and standards will contribute

The IEC Systems work

The IEC recognises that, while electrical and electronics standards are vitally important, they are often only part of the solution to a system requirement.

We therefore need to understand the whole system in order to be sure that the IEC standards properly contribute to its requirements

The main role of the Smart Cities Systems Committee is therefore to analyse the systems that make up Smart Cities, and then provide information to the relevant IEC Technical Committees to enable them to develop the electrotechnical standards needed.

We also work closely with ISO, ITU-T, and other relevant Standards Development Organisations in order to ensure that the electrotechnical standards that are developed by IEC TCs form a consistent part of the family of international standards that are being developed to meet the needs of cities.

The IEC SyC Smart Cities

Our scope: *To foster the development of standards in the field of electrotechnology to help with the integration, interoperability and effectiveness of city systems.*

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Developing families of standards

- One of the ways to foster the development of standards is by undertaking systems analysis to identify and scope out the standards needed.

- This will not only help IEC technical committees as they develop electrotechnical standards for use in city systems but will also support the whole Standards Development Community in creating families of standards to tackle city needs.

- We are undertaking a series of reports on use case collection and analysis for different city systems and system solutions.

- We are looking at City Information Modelling because the electrical distribution systems in a city need to be modelled in a way that is consistent with how all the other infrastructure systems in the city are being modelled.
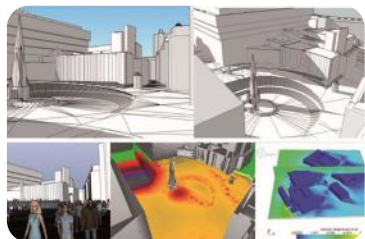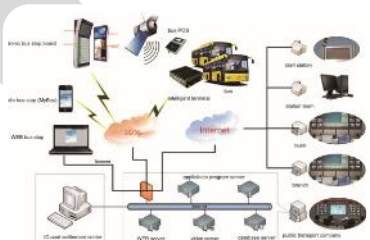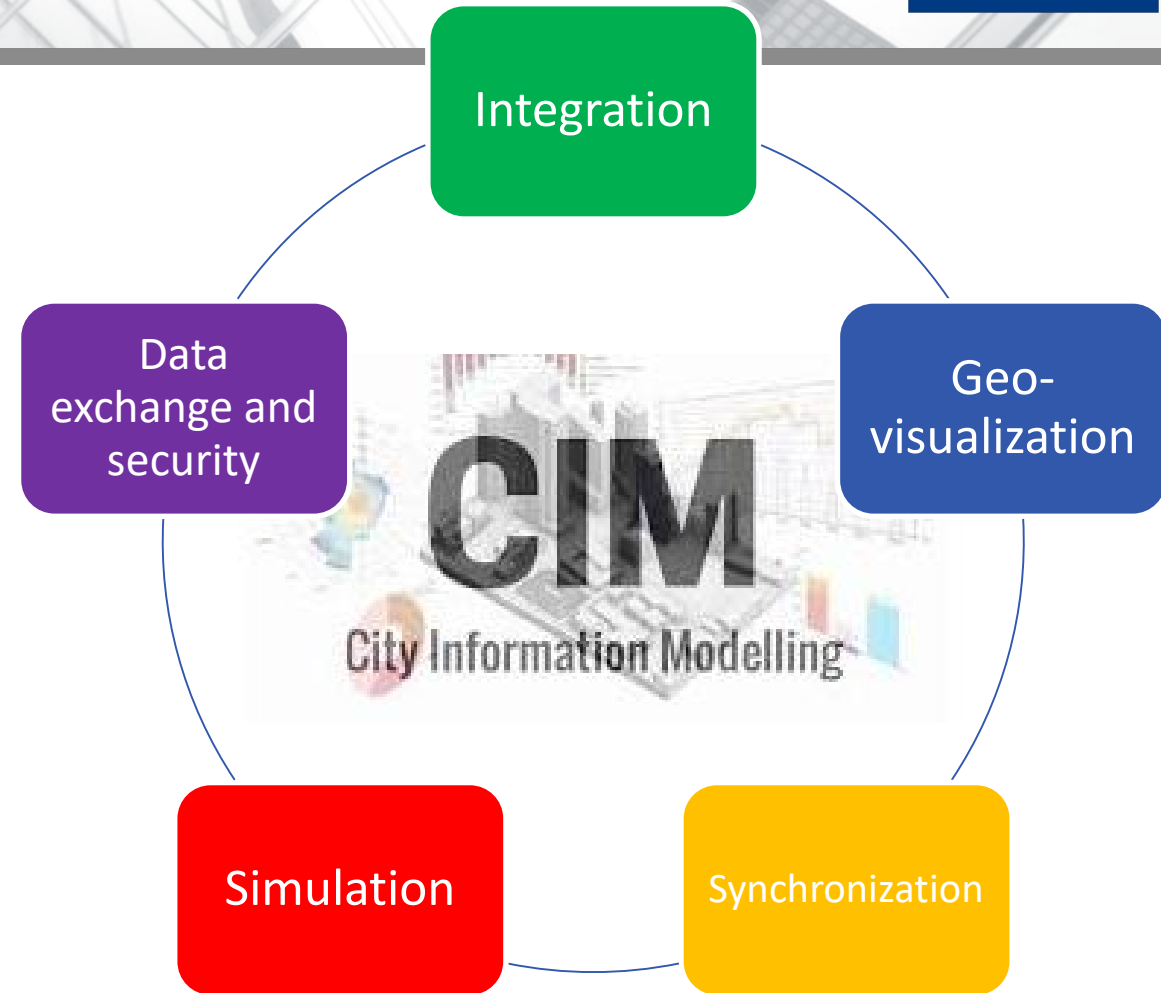
Definition of City Information Modelling

the development of digital representations of a city made up of large quantities of geo-located data, often including real time data, which enable better city planning and management.

Note 1: The geo-located data is provided using an integration of Building Information Modeling (BIM) and Geographic Information Systems (GIS).

Note 2: The real-time data is obtained through extensive use of IoT sensors within the city.
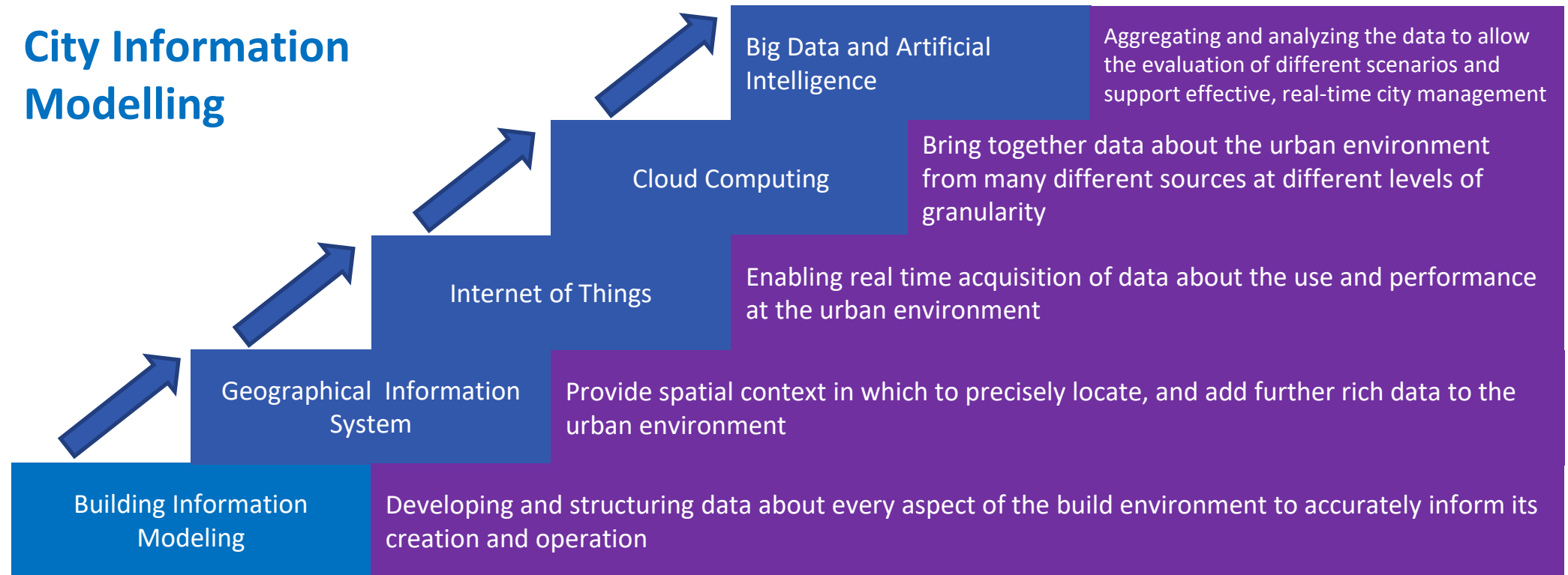
Note 3: City Information Modeling involves handling large amounts of big data, which is generally brought together using cloud computing.

Note 4: Artificial intelligence is often used to generate and evaluate different scenarios using City Information Modeling data to help manage the city better.

Integration

Data exchange and security

Geo-visualization

Simulation

Synchronization

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City Information Modelling and Its Closely Related Components

City Information Modelling

Big Data and Artificial Intelligence — Aggregating and analyzing the data to allow the evaluation of different scenarios and support effective, real-time city management

Cloud Computing — Bring together data about the urban environment from many different sources at different levels of granularity

Internet of Things — Enabling real time acquisition of data about the use and performance at the urban environment

Geographical Information System — Provide spatial context in which to precisely locate, and add further rich data to the urban environment

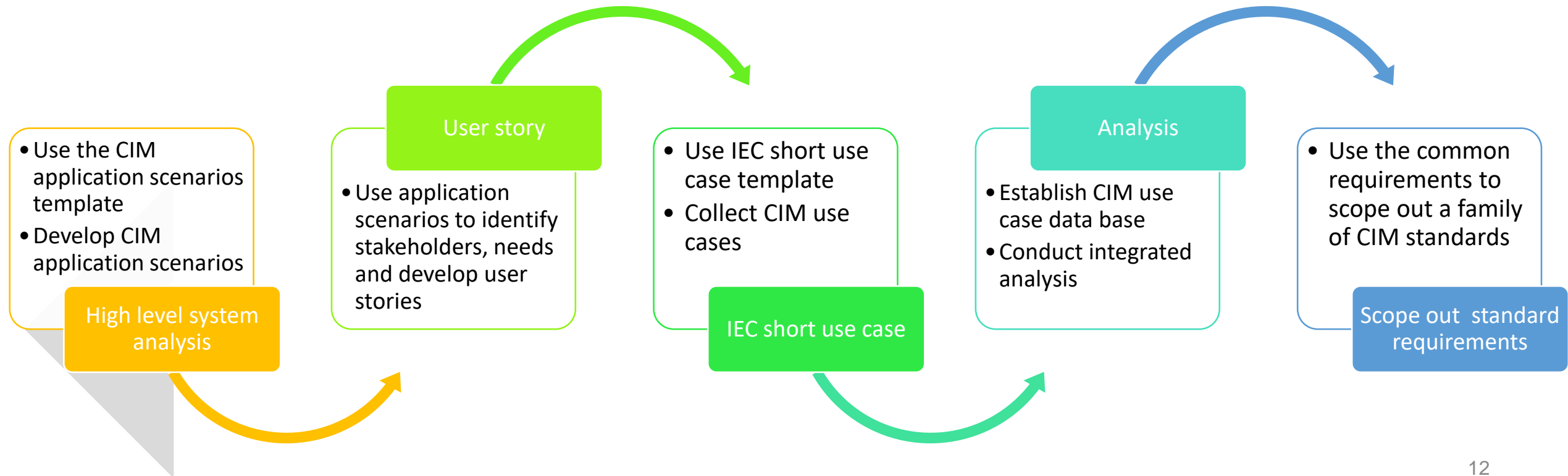**Building Information Modeling** — Developing and structuring data about every aspect of the build environment to accurately inform its creation and operation

Aims and methods of City Information Modelling use case collection and analysis

Aims:

To scope out the requirements of City Information Modeling standards by collecting and analyzing multiple use cases, specially including electrotechnical aspects.

User story

Analysis

- Use the CIM application scenarios template
- Develop CIM application scenarios

High level system analysis

- Use application scenarios to identify stakeholders, needs and develop user stories

- Use IEC short use case template
- Collect CIM use cases

IEC short use case

- Establish CIM use case data base
- Conduct integrated analysis

- Use the common requirements to scope out a family of CIM standards

Scope out standard requirements

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Importance of use case collection in standard development

Definition of 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]

The concept of use case modelling was introduced as a software development approach (Jacobson, 1992). Since then, use case modelling has become a popular and widely used technique for capturing and describing the functional requirements of a software system. It is also an important technique for standards development.

- It is efficient to capture and describe the functional requirements of a system, such as a software system;
- It is an effective tool to facilitate the communication between stakeholders in development projects;
- It supports the development process and promote a good understanding of the requirements among the stakeholders.
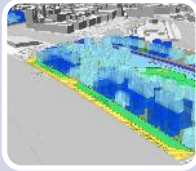
3D Modelling and City Information Modelling Application Areas

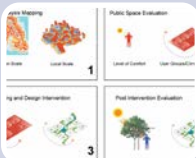| Urban planning for existing city | New town planning | Construction approval management | Project management during construction | Virtual hand-over and commissioning | Real estate registration management | City management/ smart city brain | City service continuity and disaster recovery | Heritage preservation and revitalization | Autonomous vehicles | Transports planning and management |

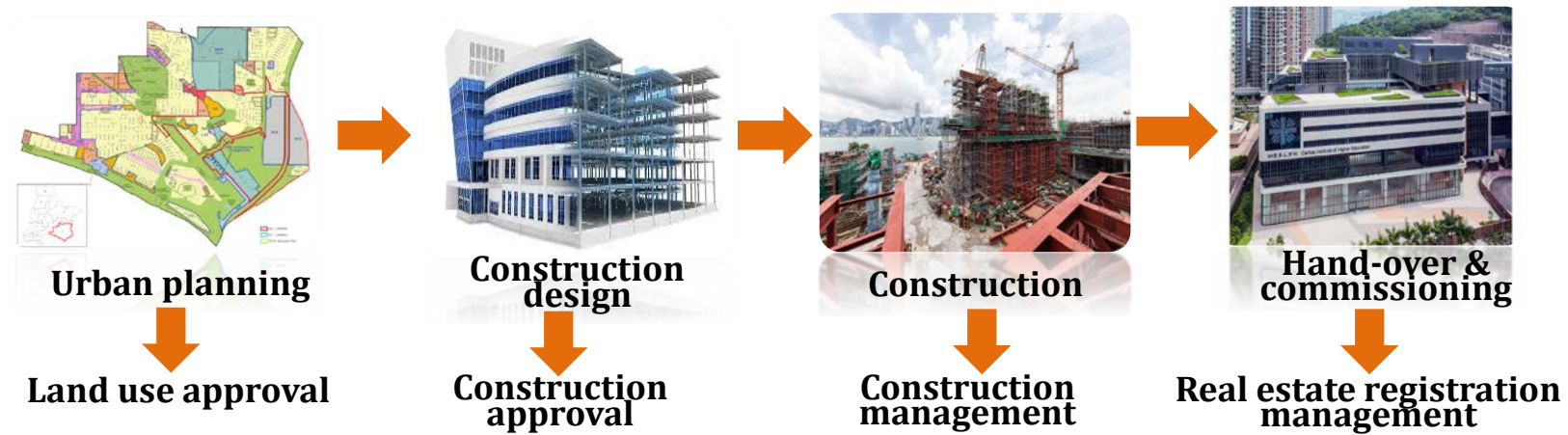| Urban waste management | Urban climate and air quality | Urban land and property taxation | Urban logistic | Management of drones | Underground combined utility tunnels | Electrical supply | Water supply and waste | Oil and gas | Telecoms | Renewable energy planning and management |

State of art of City Information Modelling and 3D Visualization

City Information Modelling can provide **an intelligent tool and platform for the work and approval** in the **whole life cycle** of construction projects.

Urban planning → Construction design → Construction → Hand-over & commissioning

Land use approval — Construction approval — Construction management — Real estate registration management
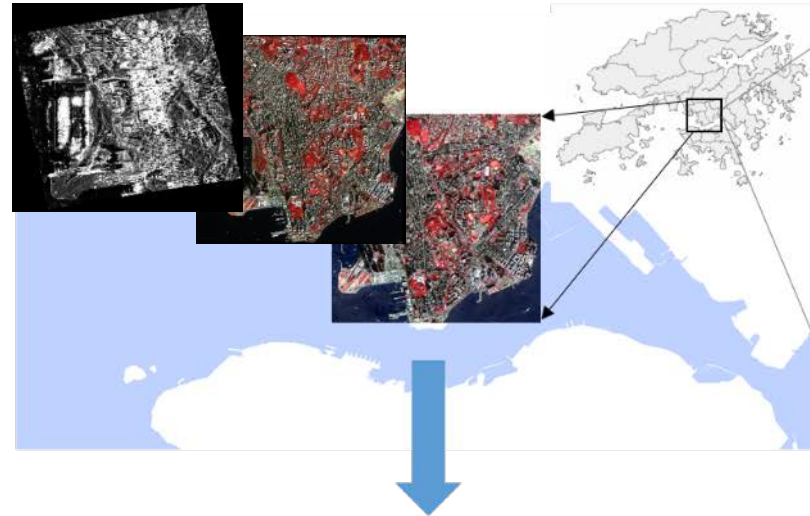
3D visualization, planning and design review

Automatic alignment between planning and construction design
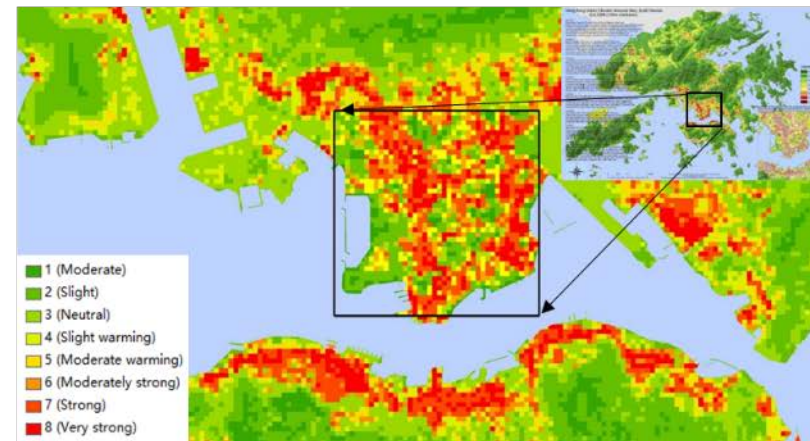
Automatic compliance verification in the stage of construction and hand-over

Applications of Extracted 3-D Urban Morphology Data

- WUDAPT level 1 & 2 applications
- Urban climatic analysis and Weather/Climatic Modelling, like WRF;
- Energy Balance study;
- Climatic-Spatial Analysis and Planning, like Urban Climatic Map;
- Early warning of high-risk urban areas with adverse urban climate issues.

1 (Moderate)
2 (Slight)
3 (Neutral)
4 (Slight warming)
5 (Moderate warming)
6 (Moderately strong)
7 (Strong)
8 (Very strong)

Urban climatic map using satellite data

Satellite-derived building morphology using our approach

Actual building morphology for comparison

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3-Dimensional Visualization of Development Applications

Objective	Current Process	Gaps	Stakeholders
Provide a geospatial 3D environment in which to ingest and display development applications (DA) that contain building models for facilitating public and expert groups discussion and comment.	Current practice includes DA listed in text with associated files for downloading and review. The package includes textual information with the option to download documents associated with application.	Lots of clicks, not easy to see what the development is, in the context of the geospatial environment or surrounding built environment. Paper and image based (tiff or pdf) plan images and modelling without ability to query, display in GIS or validate against data	1.General Public/Citizens 2.A special interest group 3.Developers 4.Local council/government

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Benefits of applying 3-Dimensional Visualization in Development Applications
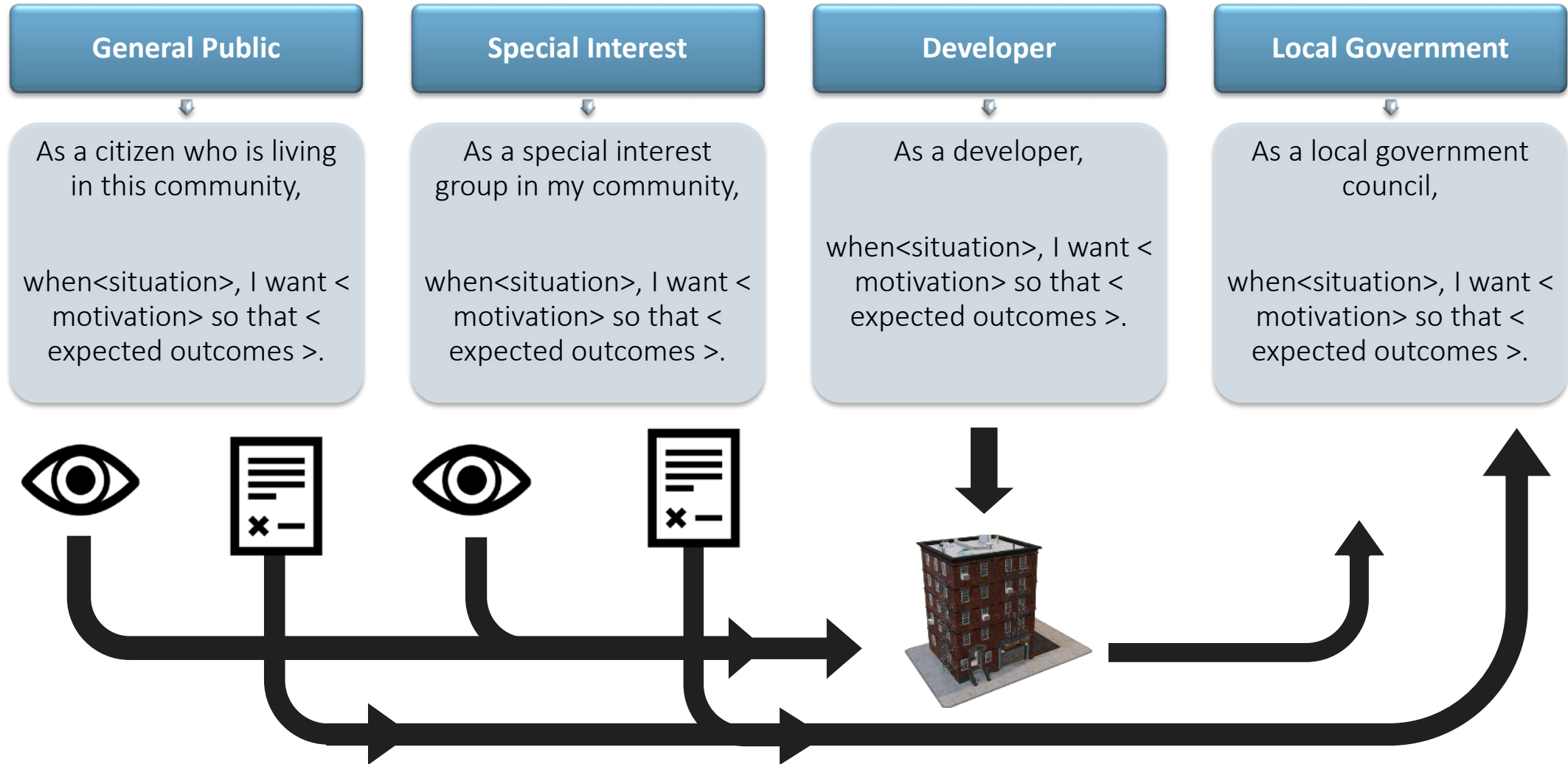
"Space ventilates our conversations and representations, making them dimensional, encouraging exploration of adjacency and association."
Source: Knowledge in 3D: How 3D Data Visualization Is Reshaping Our World, Victoria Szabo July 11, 2018

A new development in a 3D visualization context (3D model, digital twin, simulation engine) provides representations that:

- Non-technical users can review
- An object (not data) in an accessible context
- Visual navigation of physical context
- View and airspace
- Visual navigation of location space
- Physical impact on physical environment
- Simulation potentials
- Wind, solar and heat potentials
- Data aggregation and analysis

Level of user stories

General Public	Special Interest	Developer	Local Government
As a citizen who is living in this community, when<situation>, I want < motivation> so that < expected outcomes >.	As a special interest group in my community, when<situation>, I want < motivation> so that < expected outcomes >.	As a developer, when<situation>, I want < motivation> so that < expected outcomes >.	As a local government council, when<situation>, I want < motivation> so that < expected outcomes >.

3D
DA
Situated

General Public

As a citizen who is living in this community, when I am aware that new developments that fall under certain categorization go on public display for comment, I want to see a 3D model and have better visualization of how the built environment of my neighbourhood, and city is changing, so that I can participate in the dialogue and ensure that the neighbourhood and city continue to be places I want to live.
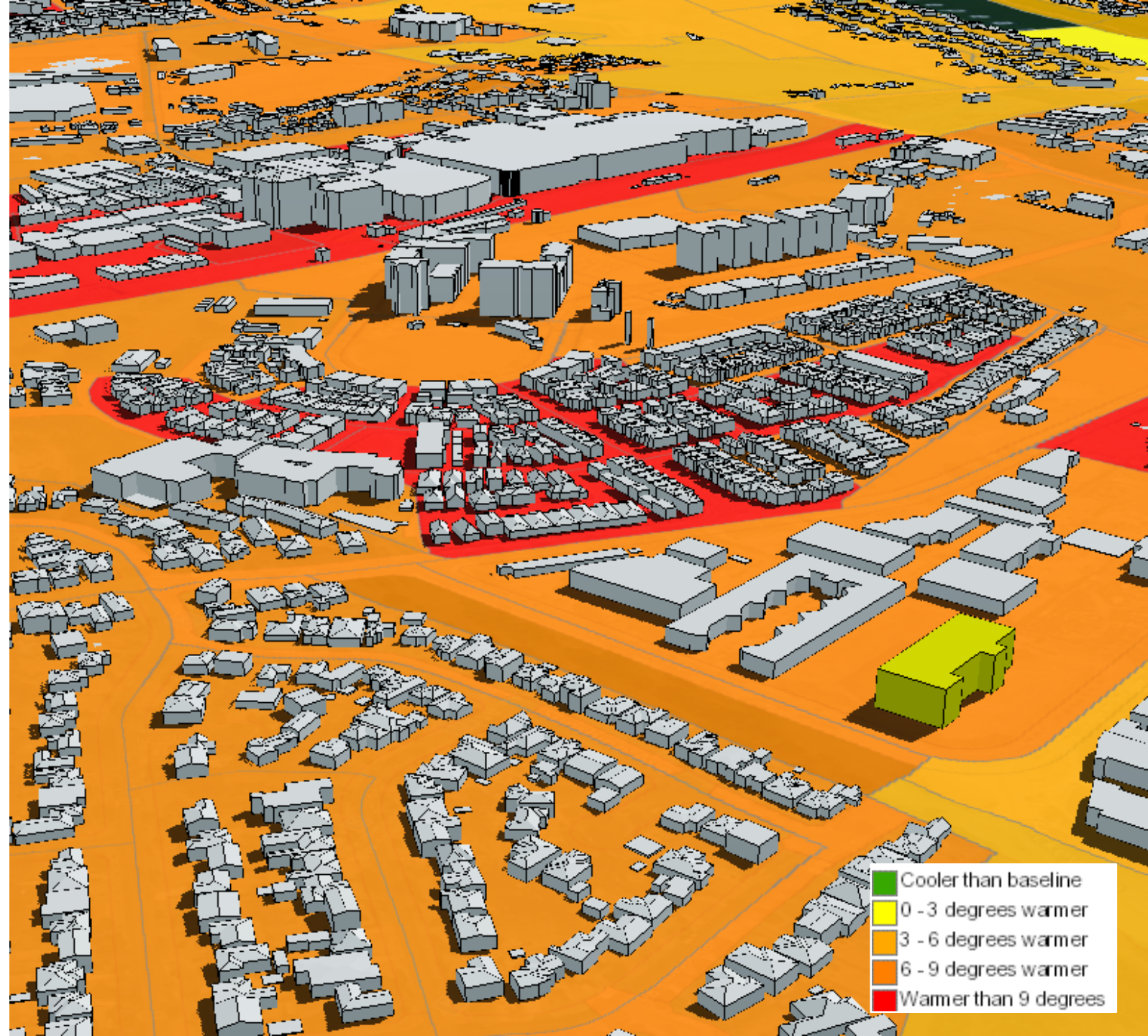
3D
DA
Situated
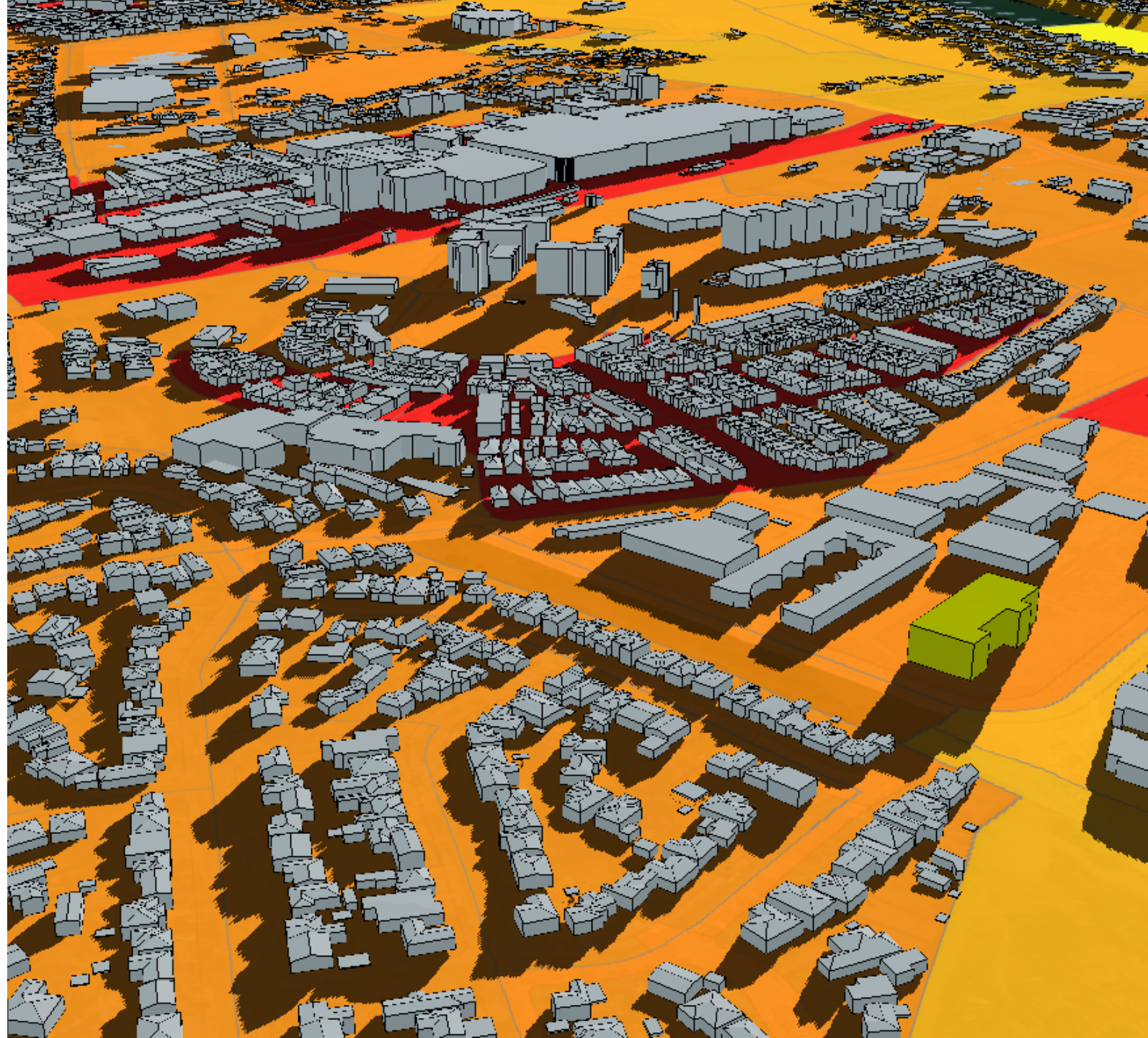
Special Interest

As a special interest climate group in my community, I am aware that new developments may affect the cities microclimate in the form of heat islands, I want to ensure that developments do not adversely affect the weather patterns within the city's microclimate, so that I can bring forward information and run simulations about the implications this may have on city's energy grid due to this increase in cooling systems being operated at one time.

Cooler than baseline
0 - 3 degrees warmer
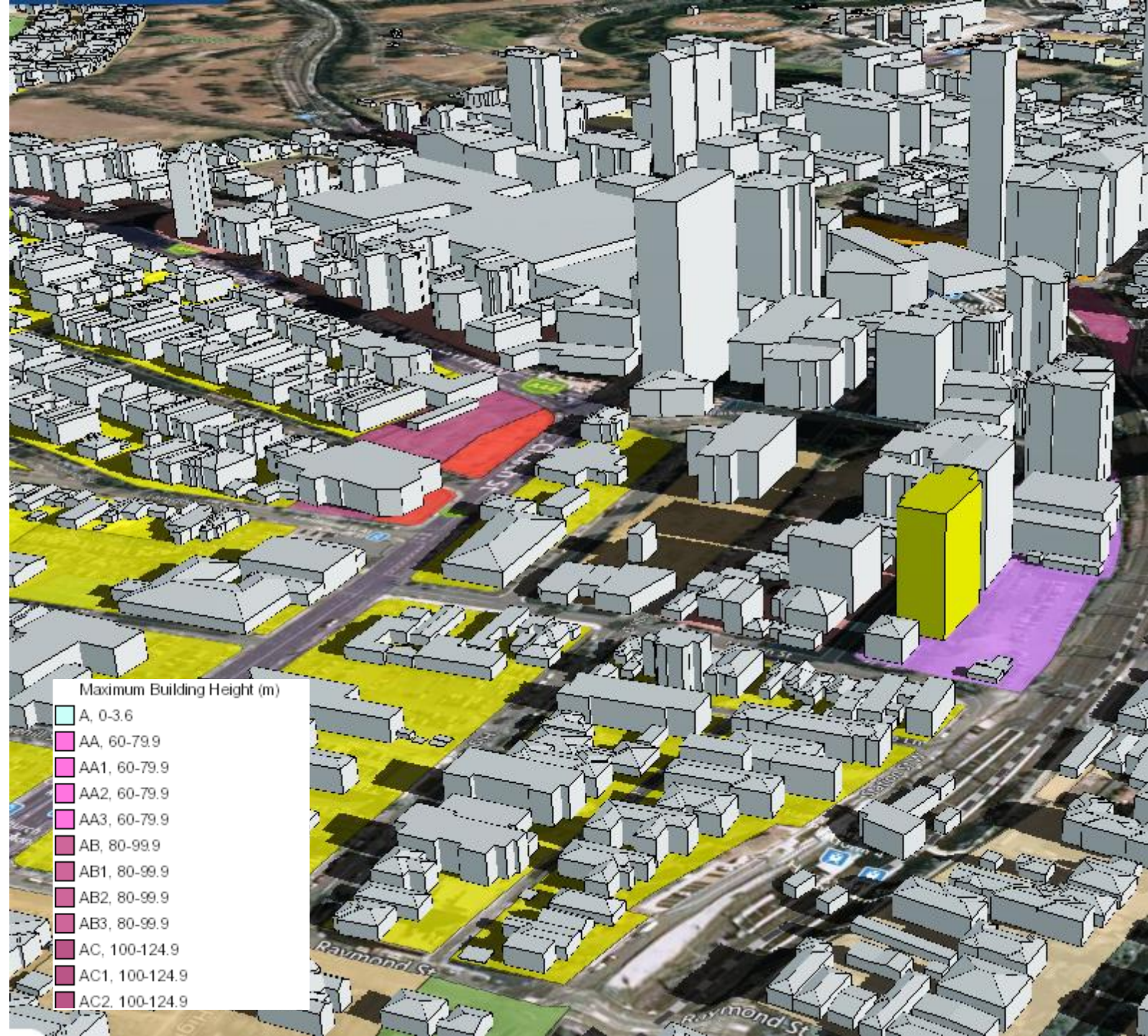3 - 6 degrees warmer
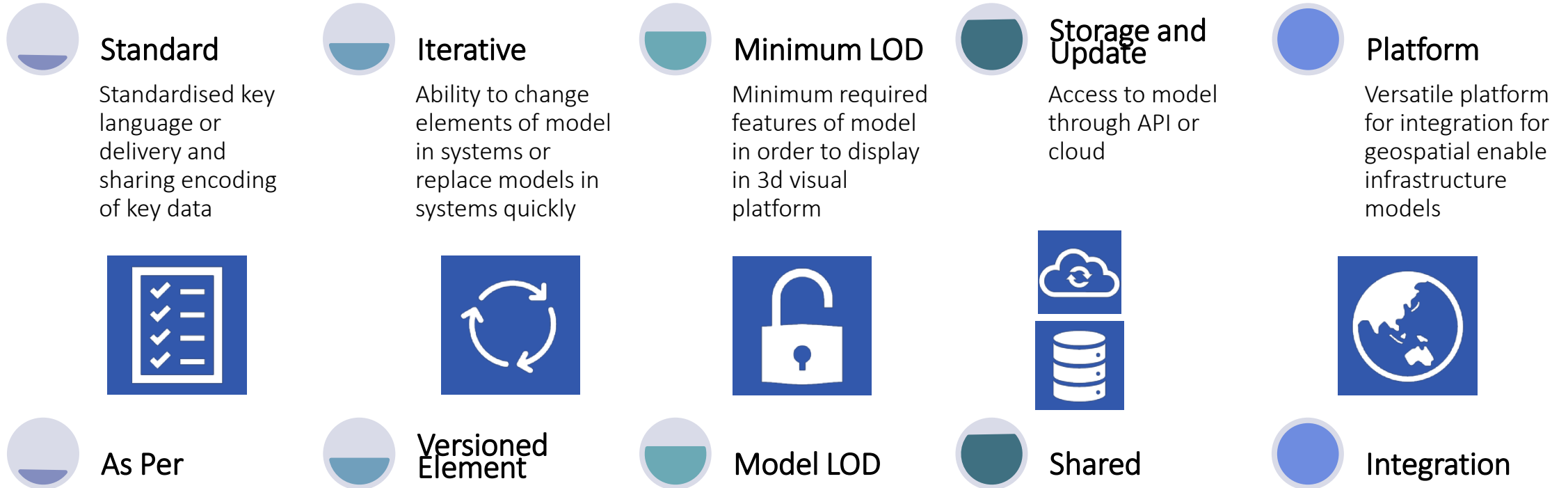6 - 9 degrees warmer
Warmer than 9 degrees

3D
DA
Situated

Local Government

As a local government council, when I am collecting comments from different stakeholders, I want to review the current developments underway in a 3-dimensional (3D) visualization development applications, so I can integrate the public exhibition of plans with the planned land use and long-term projects of land use in that precinct.

Maximum Building Height (m)
- A, 0-3.6
- AA, 60-79.9
- AA1, 60-79.9
- AA2, 60-79.9
- AA3, 60-79.9
- AB, 80-99.9
- AB1, 80-99.9
- AB2, 80-99.9
- AB3, 80-99.9
- AC, 100-124.9
- AC1, 100-124.9
- AC2, 100-124.9

Preliminary findings of the requirements

Standard

Standardised key language or delivery and sharing encoding of key data

Iterative

Ability to change elements of model in systems or replace models in systems quickly

Minimum LOD

Minimum required features of model in order to display in 3d visual platform

Storage and Update

Access to model through API or cloud

Platform

Versatile platform for integration for geospatial enable infrastructure models

As Per

Versioned Element

Model LOD

Shared

Integration

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Discussion

- 3D visualization is a critical important component of City Information Modelling.
- Requirements for 3D Visualization of development application
  - Standard formats and encoding for sharing data
  - Platform to process and receive geospatial data for visualization,
  - Legislations to mandate the submission of digital 2D or 3D plan data for proposed developments
- We need experts of 3D visualization to join the City Information Modelling use case collection and analysis project (Ref. IEC SRD 63273).
- Welcome to join project IEC SRD 63273 and apply IEC SyC Smart Cities R-membership.

Project information

Project Name: Systems Reference Deliverable - Use Case Collection and analysis: City Information Modeling for Smart Cities

Project Leader: Dr. Biao Liu

Project Secretary: Dr. Chunlan Guo

Project Code: IEC SRD 63273

Duration: Nov 2019 to Nov 2021

Website: https://www.iec.ch/dyn/www/f?p=103:38:11064445184 136::::FSP_ORG_ID,FSP_APEX_PAGE,FSP_PROJECT_ID:13073,23,10 3401

Current stage: ACD (Approved Community Draft) (Nov 2020)

Contact: Dr. Chunlan Guo, chunlanguo@outlook.com

QR code to access the project website

IEC SRD 63273

We want to thank

Thank You!