FIG 2014

Utilising the Virtual World for Urban Planning and Development

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Paper Outline

7 steps in the Virtual Urban Citymodel Process:

1. **User Needs Assessment**
2. **Data Quality**
3. **Data Acquisition**
4. **Visualisation**
5. **Functionality**
6. **Maintenance**
7. **Proposal Dissemination**

Case Studies.

1. User Needs Assessment

1. Identify potential users
2. Understand their needs
3. Clarify their intended functionality

Utilise User Stories:
"I am a [user definition] and I would like to …"

Classify User Stories into:
Must have, Should have, Could have, Wont have

Get signoff by Project Sponsors.

2. Data Quality

Review the Data required to meet User Needs:

1. Accuracy
2. Precision
3. Reliability
4. Currency
5. Completeness
6. Reality.

2. Data Quality

Reality and Accuracy:

Everybody *wants* higher degrees of Reality, but some users *need* higher degrees of Accuracy.

Higher Accuracy

User Stories dominate with references to court hearings, legal planning decisions, measurement functionality, references to other datasets and other applications where "***it has to be right***".

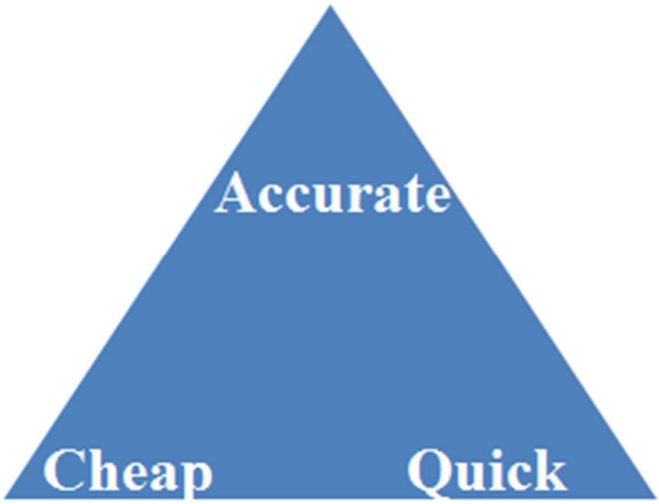
Higher Reality

User Stories dominate with references to visual appeal, aesthetics, public consultation, visual amenity, and other applications where "***it has to look right***".

2. Data Quality

Reality and Accuracy:

Everybody *wants* higher degrees of Reality, but some users *need* higher degrees of Accuracy.



3. Data Acquisition

Review the Data Acquisition methodologies against the Data Quality criteria:

1. **Satellite imagery**
2. **Aerial photography**
3. **Oblique aerial photography**
4. **Airborne LiDAR**
5. **Terrestrial LiDAR**
6. **Terrestrial imagery**
7. **Existing building footprints**
8. **As built plans**
9. **UAVs.**

3. Data Acquisition

Satellite Imagery	
Pros: – Little (or no) site access required – Significant archives available – Often cost efficient – Cloudy areas can be captured without paying standby aircraft charges	Cons: – Low resolution (0.5m at best) – poor resolution for capturing façades – archive imagery may be out of date
Aerial Photography	
Pros: – very high resolution available – archives may be available – versatility with bespoke capture – rapid and efficient capture once on site	Cons: – ATC & possibly military permits reqd – poor geometry for capturing façades – archive imagery may be out of date – higher startup costs

3. Data Acquisition

Oblique Aerial Photography	
Pros: – simultaneous nadir & oblique imagery – defines façade textures and geometry – supports crisp vector definition – good definition of upper building parts – access to all sides of every building – rapid and efficient capture once on site	Cons: – ATC & possibly military permits – many flightlines for dense definition – poor definition of lower building parts – higher startup costs
Airborne LiDAR	
Pros: – simultaneous LiDAR and imagery – good definition of upper building parts – access to all sides of every building – rapid and efficient capture once on site	Cons: – geometry inferred from point data – building lines confused by data noise – crisp building lines need high density – poor definition of lower building parts – higher startup costs

3. Data Acquisition

Terrestrial LiDAR	
Pros: – simultaneous LiDAR and imagery – efficient mobile (vehicle) capture – good definition of lower building parts – high point density available – lower startup costs	Cons: – less access to rear side of buildings – may require entering private property – lower accuracy in urban canyons – poor definition of upper building parts – buildings obscured by fences or trees – facades obscured by traffic
Terrestrial Imagery	
Pros: – inexpensive GPS/attitude cameras – skilled labor not required – can access buildings by foot or vehicle – lower startup costs	Cons: – provides poor building geometry – less access to rear side of buildings – may require entering private property – buildings obscured by fences or trees

3. Data Acquisition

Existing Building footprints Pros: – no site access required – low cost – ensure consistency with other data layers	Cons: – footprints may have variable accuracy – no shape in the building upper stories – building height required from elsewhere – building texture required from elsewhere
As built Plans Pros: – no site access required (for this project) – lower cost	Cons: – rarely complete dataset available – often inaccurate building location – building texture required from elsewhere

3. Data Acquisition

Design Plans Pros: – no site access required – allows proposals to be assessed – good for maintaining existing citymodels	Cons: – doesn't support building existing cities
UAVs Pros: – small areas can be updated inexpensively	Cons: – Public safety / liability concerns of UAVs in cities – Can become expensive over larger areas

3. Data Acquisition

Aerial versus Terrestrial Cityscape Capture

1. **Aerial Capture provides:**
    1. *Greater access to more building facades*
    2. *Greater efficiency in data capture*
    3. *Definition of rooflines*
    4. *More perspectives on more facades*
    5. *Required perspective for more planning purposes*

2. **But is limited by:**
    1. *Shadows*
    2. *Building awnings*
    3. *Vegetation*
    4. *Urban canyon.*

3. Data Acquisition

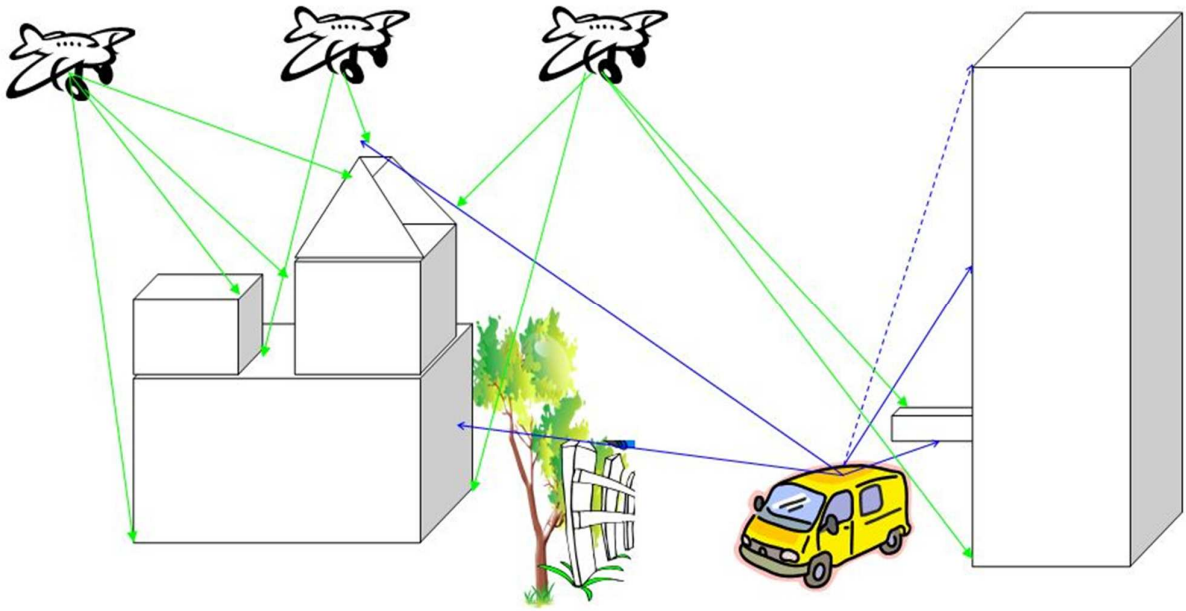
Aerial versus Terrestrial Cityscape Capture

1. **Terrestrial Capture provides:**
    1. *Clearer access to prominent facades*
    2. *Higher resolution*

2. **But is limited by:**
    1. *Facades accessible by vehicle or on foot*
    2. *Poor building geometry definition (other than streetscape)*
    3. *Building awnings*
    4. *Vegetation*
    5. *Less efficiency in data capture over large areas*
    6. *traffic.*

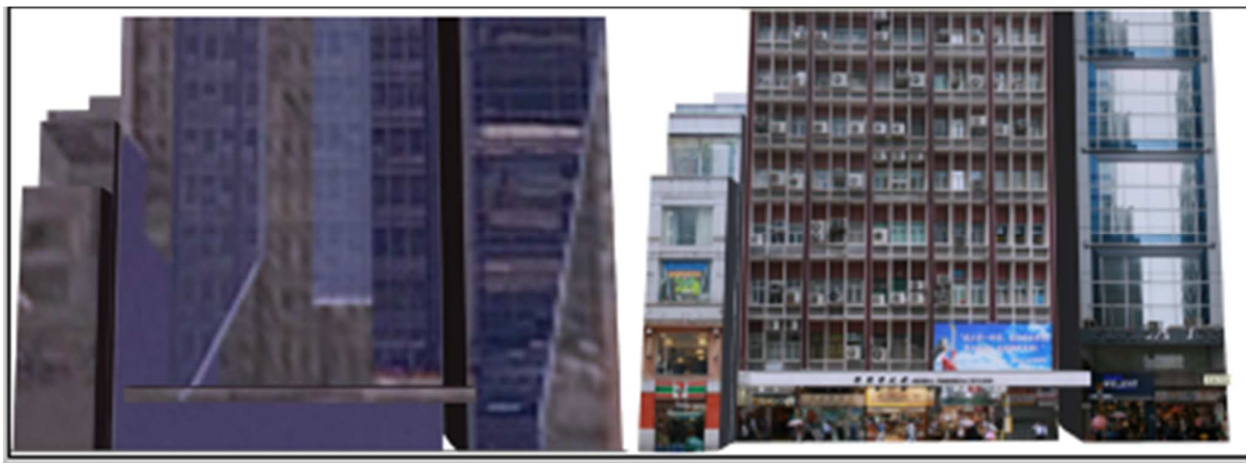
3. Data Acquisition

Aerial versus Terrestrial Cityscape Capture



3. Data Acquisition

Aerial versus Terrestrial Cityscape Capture

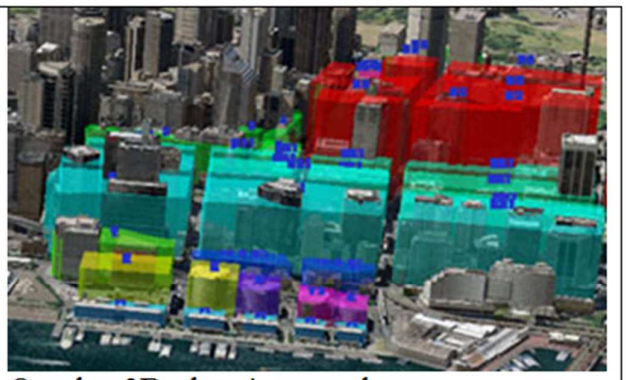


Capture geometry and overall textures from the air

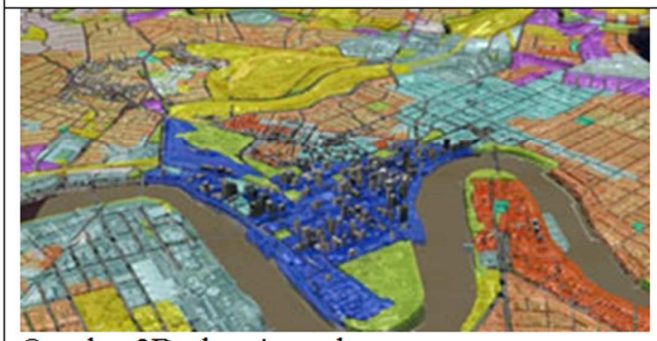
Supplement aerial geometry with terrestrial textures.

4. Visualisation

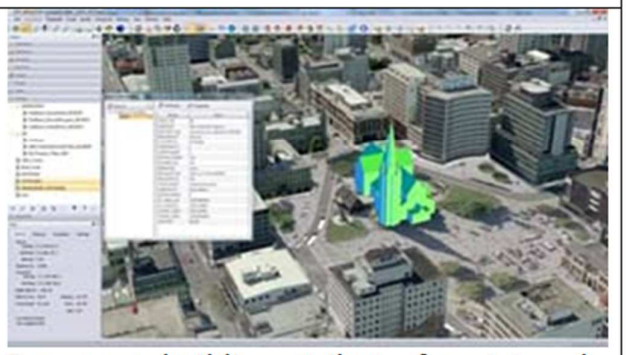
Viewing on workstation, web or kiosk



Overlay 3D planning envelopes



Overlay 2D planning schemes

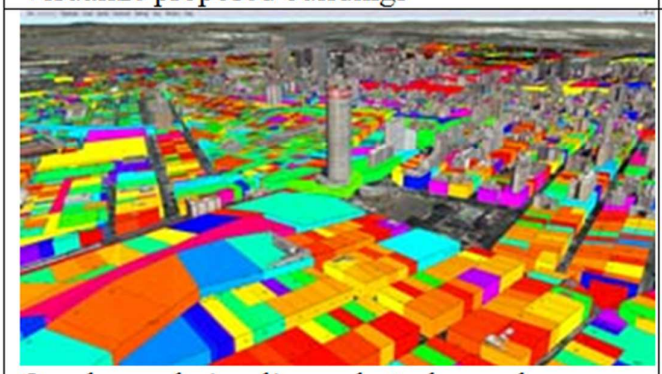


Interrogate building attributes from internal or external source (eg. ArcGIS)

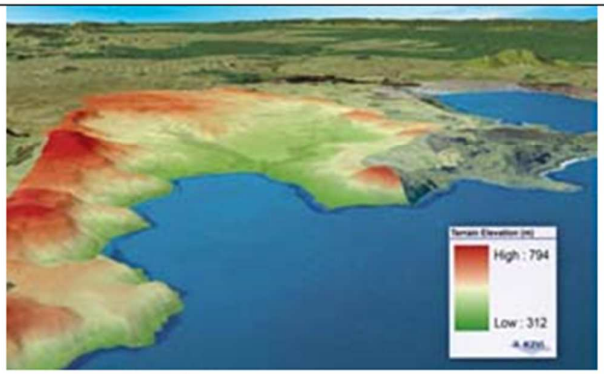
4. Visualisation

Visualize proposed buildings

Add street level photography



Overlay and visualize cadastral parcels



Consume web services

4. Visualisation

Turn surface opaque to view underground assets

Add realistic water modelling & reflections

Wave modelling with wind direction & speed

Accurate cloud and light modelling

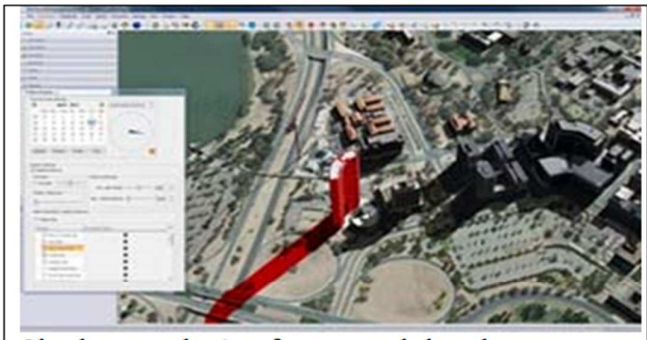
4. Visualisation

Overlay road markings and animated vehicles

Symbolise assets (trees) from database

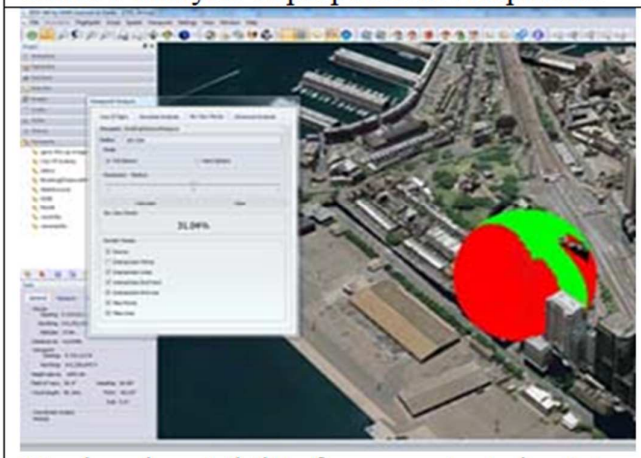
Visualisations from K2Vi software

5. Functionality

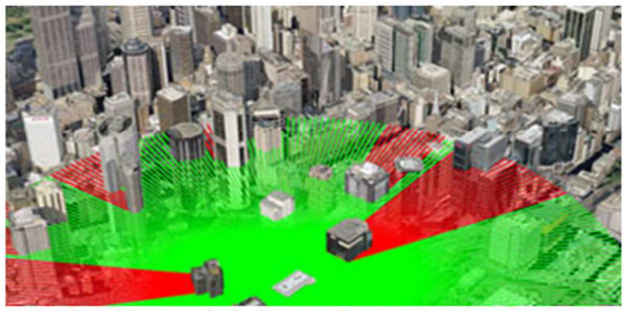


Shadow analysis of proposed developments

Measurement: linear, areal, slope, aspect

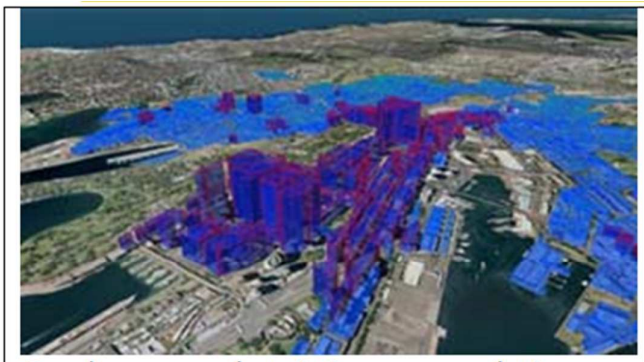


Display sky visibility from nominated point



Conduct line of sight analysis

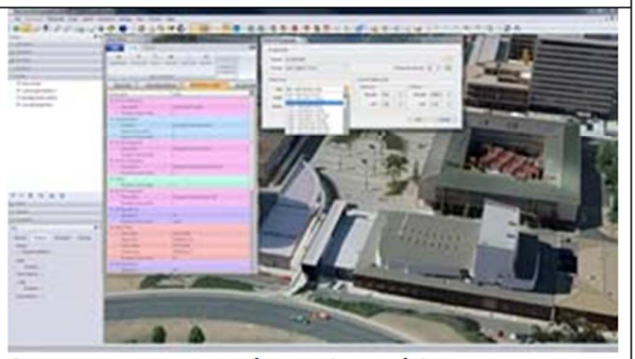
5. Functionality



Overlay external statistics, eg. population

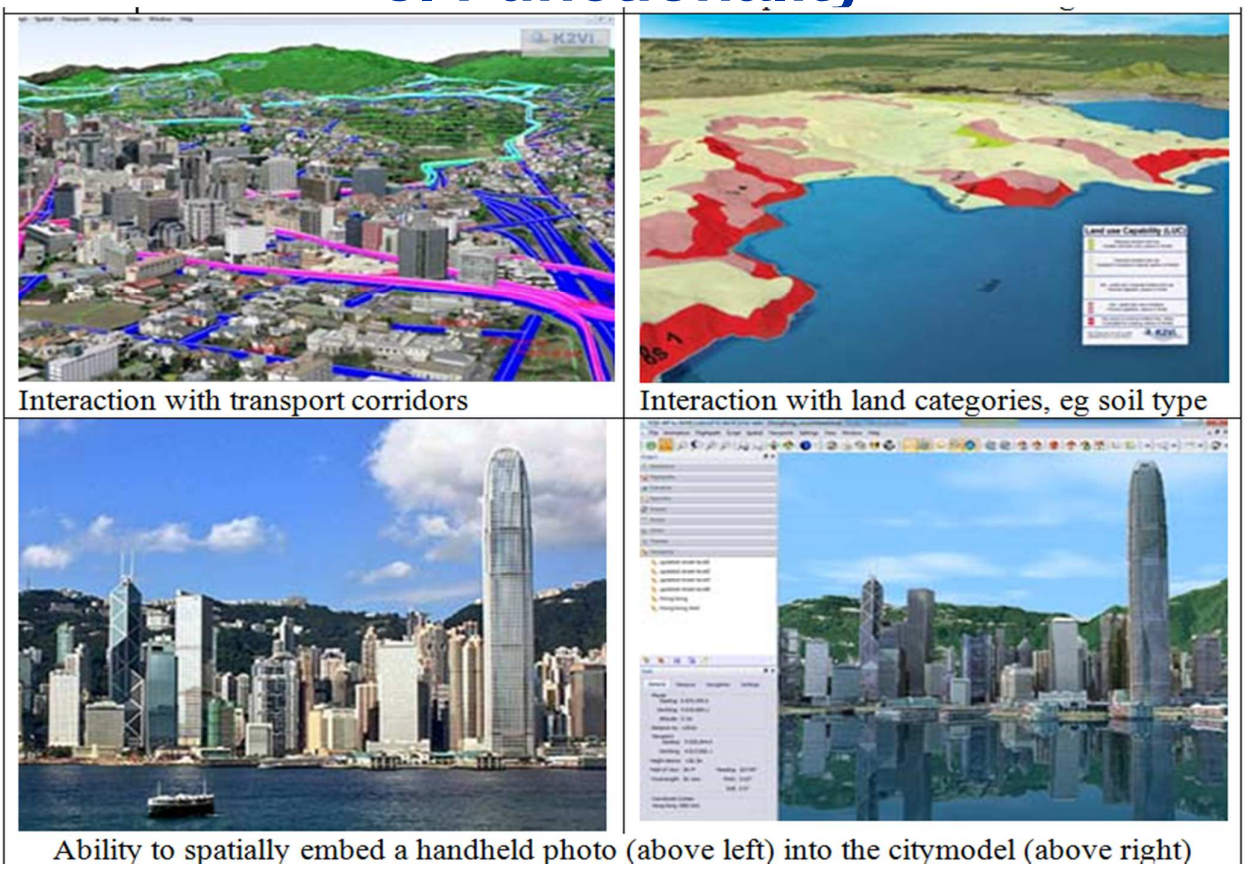
Search models by SQL Query

Visualise water inundation



Screen capture and movie making

5. Functionality



Interaction with transport corridors

Interaction with land categories, eg soil type

Ability to spatially embed a handheld photo (above left) into the citymodel (above right)

6. Maintenance

Need to maintain confidence in Urban Model:

1. **Planning Process**
   mandate planning applications include new models

2. **Specific Update**
   use planning process to identify changes for survey

3. **Complete Remap**
   remap city at periodic intervals

4. **Partial Remap**
   remap highly dynamic areas (between complete remap)

Pros and cons in paper

7. Proposal Dissemination

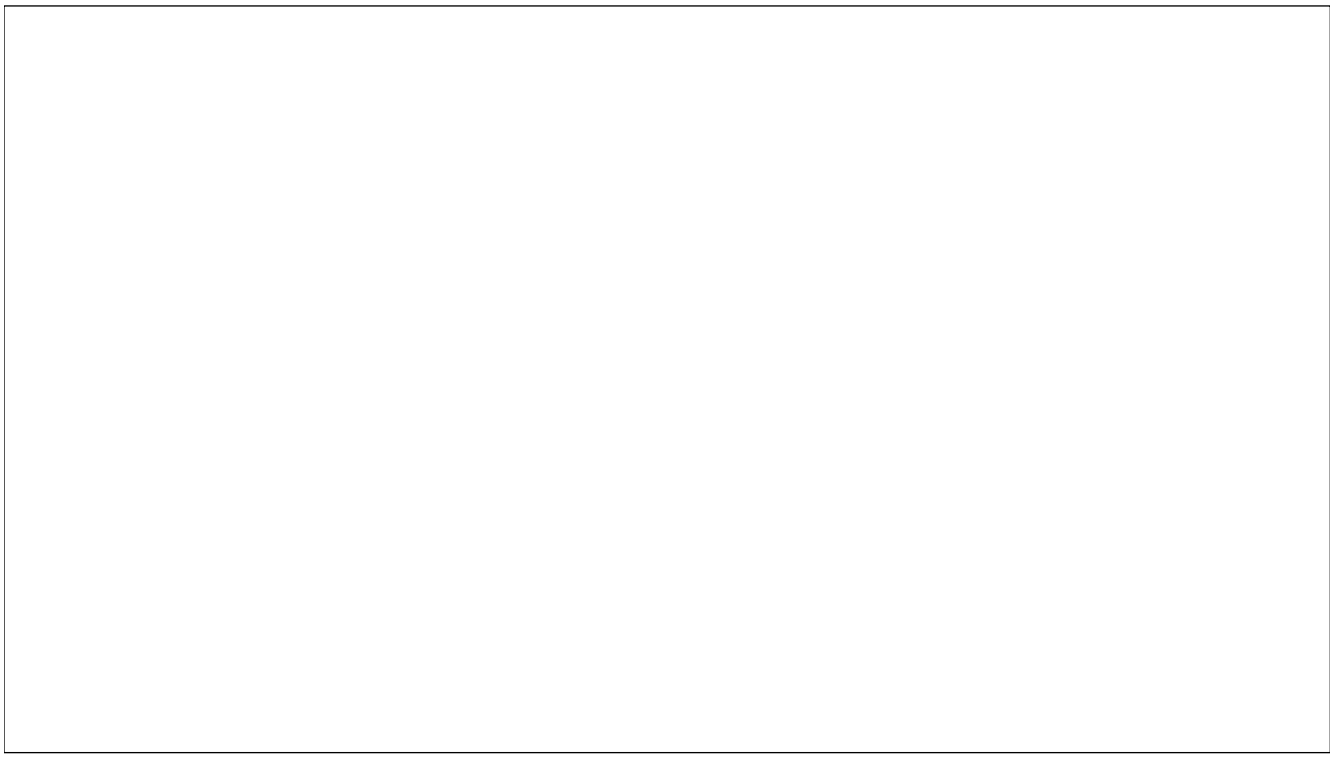
City of Melbourne uses Facebook to help disseminate planning schemes to stakeholders:

Case Studies

Managing Urbanisation

Case Studies

Urban Landuse Planning



Closing

Work from the Whole to the Part:

so that each component can play an appropriate role in achieving the agreed result.

Process:

- uncover and clarify the needs to be met
- design a Virtual World to meet those needs
- define the functionality to utilise the Virtual World
- outline the data to support the functionality
- establish maintenance programs to provide enduring confidence in the Virtual World

Thank You